SECTION INDEX
TOYOTA FBMF 16-30

< Tillbaka till Index

FOREWORD

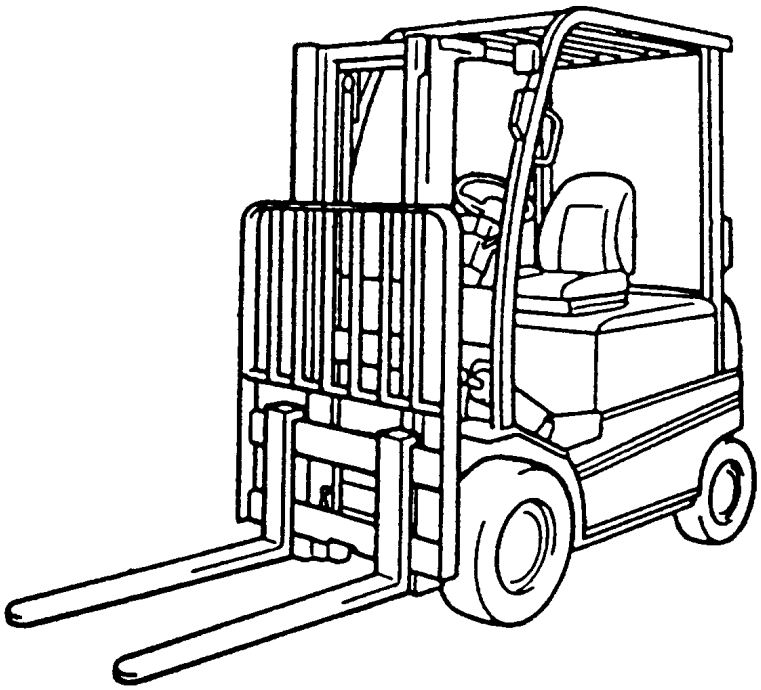
This manual covers the service procedures of the TOYOTA BATTERY FORKLIFT FBMF16 ~ 30 Series. Please use this manual for providing quick, correct servicing of the corresponding forklift models.

This manual deals with the above models as of June 1996. Please understand that disagreement can take place between the descriptions in the manual and actual vehicles due to change in design and specifications. Any change or modifications thereafter will be informed by Toyota Industrial Vehicles' Parts & Service News.

TOYOTA Material Handling Company
A Division of TOYOTA INDUSTRIES CORPORATION

GENERAL

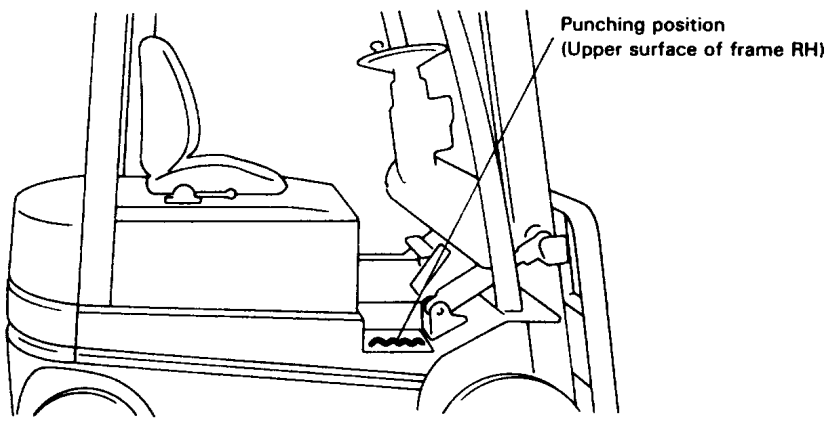
EXTERIOR VIEWS



VEHICLE MODELS

Item \ Model		FBMF16	FBMF20	FBMF25	FBMF30
Load capacity kg (lb)		1600 (3200)	2000 (4000)	2500 (5000)	3000 (6000)
Voltage V		72/80	←	←	←
Battely capacity AH/5H	STD capacity	360	480	←	600
	Max. capacity	450	600		750

FRAME NUMBER



Model	Punching format
FBMF16 :	FBMF16 Ⓔ 10001 ~
FBMF20·25:	FBMF25 Ⓔ 10001 ~
FBMF30 :	FBMF30 Ⓔ 10001 ~

LIST OF REFERENCE PAGES IN PUBLISHED NEW MODEL FEATURES

The FBMF16, 20, 25 and 30 are based on the body for FBM 16 to 30.
For the sections not included in this manual, please refer to the published new model features for the FBM16 to 30 (No. PE301). This list shows the reference pages for each section.

Item (published new model features for the FBM16 to 30)		FBMF16·20·25·30
ELECTRICAL SYSTEM	BATTERY	*2-2
	CHARGER	–
	ACCELERATOR	←
	DRIVE MOTOR	←
	PUMP MOTOR	←
	POWER STEERING MOTOR	←
	CONTROLLER	*2-5
POWER TRAIN	DRIVE UNIT	←
DRIVE, STEERING AND BRAKE SYSTEM	FRONT AXLE	←
	REAR AXLE	*2-6
	WHEELS	*2-7
	STEERING	*2-8
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	INSTRUMENTS	*2-12
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	Diagnosis	←
	Analyzer	←
MATERIAL HANDLING AND HYDRAULIC SYSTEMS	V MAST	2-13
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	OIL PUMP	*2-21
	OIL CONTROL VALVE	←
	HYDRAULIC CIRCUIT	*2-22

*: Only the modified points are described.

HOW TO READ THIS MANUAL

EXPLANATION METHOD

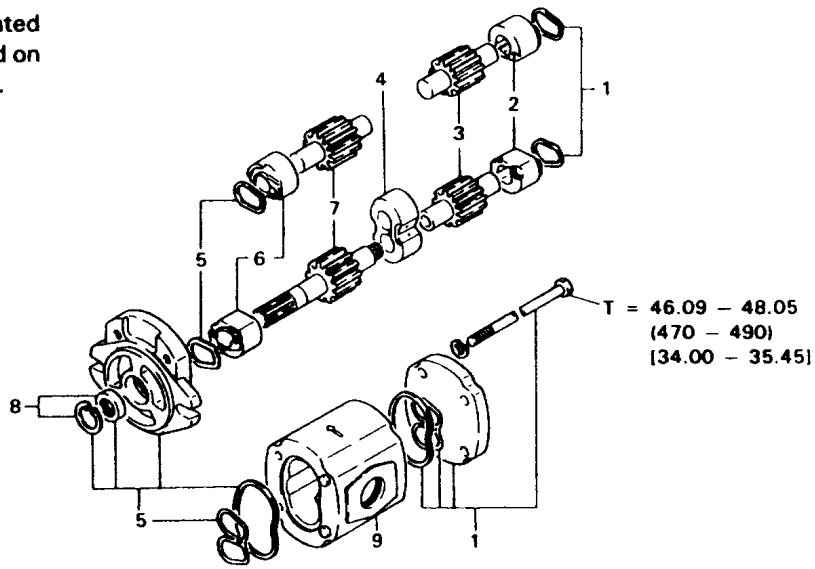
1. Operation procedure
   (1) The operation procedure is described in either pattern A or pattern B below.
   Pattern A: Explanation of each operation step with illustration.
   Pattern B: Explanation of operation procedure by indicating step numbers in one illustration, followed by explanation of cautions and notes summarized as point operations.

Example of description in pattern B

DISASSEMBLY·INSPECTION·REASSEMBLY Tightening torque unit T = N·m (kgf-cm) [ft-lbf]

If a place or part cannot be indicated directly, the part name is described on the either side of the illustration.

Example: 1 Piping



Disassembly Procedure

1 Remove the cover. **[Point 1]**

2 Remove the bush. **[Point 2]** ← Operation explained later

3 Remove the gear.

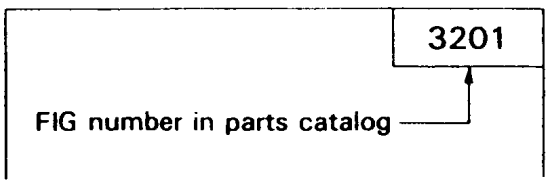
Point operations Explanation of key point for operation with an illustration

[Point 1]
Disassembly: Put a match mark when removing the pump cover.

[Point 2]
Inspection: Measure the bush inside diameter.
Bush inside diameter limit: 19.12 mm (0.7528 in)

2. How to read components figures
   (1) The components figure uses the illustration in the parts catalog for the vehicle model. Please refer to the catalog for checking the part name.
   The number at the right shoulder of each components figure indicates the Fig. number in the parts catalog.

(Example)



3. Matters omitted in this manual
   (1) This manual omits description of the following jobs, but perform them in actual operation:
   ① Cleaning and washing of removed parts as required
   ② Visual inspection (partially described)

TERMINOLOGY

Caution:
Important matters of which negligence may cause accidents. Be sure to observe them.

Note:
Important items of which negligence may cause accidents, or matters in operation procedure requiring special attention.

Standard: Values showing allowable range in inspection and adjustment.
Limit: Maximum or minimum allowable value in inspection or adjustment.

ABBREVIATIONS

Abbreviation (code)	Meaning	Abbreviation (code)	Meaning
ASSY	Assembly	SST	Special service tool
LH	Left hand	STD	Standard
LLC	Long life coolant	T =	Tightening torque
OPT	Option	○ ○ T	Number of teeth (○ ○)
O/S	Oversize	U/S	Undersize
PS	Power steering	W/	With
RH	Right hand	L/	Less
SAE	Society of Automotive Engineers (USA)		

ELECTRICAL SYMBOLS

Symbol	Name	Symbol	Name	Symbol	Name
ANL	Analyzer	EPS	Electrical Power Steering	PB_{SPS}	SPS Print Board
ASSY	Assembly			PL_W	Working Pilot Lamp
BATT	Battery	F1	Drive Fuse	PS	Power Steering
B_Z	Buzzer	F2	Pump Fuse	RAD	Drive Absorber Resistor
CAD	Drive Absorber Capacitor	F3	Power Steering Fuse	RAP	Pump Absorber Resistor
		F4	Lamp Fuse	RCK1/2	Check Resistor, No 1/2
CAG	Regenerative Absorber Capacitor	F5	Control Circuit Fuse	RAG	Regenerative Absorber Resistor
		F6	Power supply		
CAP	Pump Absorber Capacitor	FR	Flasher Relay	ROM	Read Only Memory
		GND	Ground	RG	Regenerative Resistor
$CHI_{F/R}$	Chime, Forward/Reverse	H	Horn	RH	Right Hand
		$L_{BU-R/L}$	Back-Up Lamp, RH/LH	SA	Surge Absorber
$CHI_{F\&R}$	Chime, Forward & Reverse	$L_{C-R/L}$	Clearance Lamp, RH/LH	SDD	Drive SIT Driver
		$L_{F-R/L}$	Flasher Lamp, RH/LH	SDP	Pump SIT Driver
CO	Overall Capacitor	$L_{F-R/LR}$	Flasher Lamp, RH/LH (Rear)	SLL	Lequid Level Sensor
CSD	Drive Current Sensor			SN1~5	Snubber, No 1~5
CSP	Pump Current Sensor	$L_{H-R/L}$	Head Lamp, RH/LH	SSP1/2	Speed Sensor, No 1/2
DAD	Drive Absorber Diode	$L_{L-R/L}$	Licence Lamp, RH/LH	SST	Special Service Tool
DAG	Regenerative Absorber Diode	$L_{R-F/R}$	Rotaly Lamp, Forward/Reverse	ST	Steering Torque Sensor
				STD	Standard
DAP	Pump Absorber Diode	$L_{ST-R/L}$	Stop Lamp, RH/LH	STH	Thermo Sensor
DC-CD	DC-CD Converter & Contactor Drive	$L_{T-R/L}$	Tail Lamp, RH/LH	SUB-ASSY	Subassembly
		L_W	Working Lamp		
DCD	Drive Clip Diode	LH	Left Hand	SW_{AC}	Accelerator Switch
DCP	Pump Clip Diode	LS_{ATT}	Attachment Limit Switch	SW_B	Brake Switch
DF1~3	Flywheel Diode, No. 1~3			SW_F	Flasher Switch
		LS_D	Dead Man Limit Switch	SW_H	Horn Switch
DG	Regenerative Diode	LS_L	Lift Limit Switch	SW_{ky}	Key Switch
DISP	Display	LS_{PB}	Parking Brake Limit Switch	SW_L	Light Switch
DM_D	Drive Motor			SW_{SC}	Speed Control Switch
DM_P	Pump Motor	LS_{ST}	Stop Lamp Limit Switch	TG	Regenerative Transistor
DM_{PS}	Power Steering Motor	LS_T	Tilt Limit Switch	TM	Main Transistor
DRD	Drive Reverse Diode	MB	Battery contactor	TMP	Main Transistor, Pump
DRP	Pump Reverse Diode	MCS-II	Multipurpose Computer Control System-II	TM_{PS}	Main Transistor, Power Steering
DS_{BU}	Buck-Up Optional Direction Switch	MF	Forward Contactor	U/S	Undersize
DS_F	Forward Direction Switch	MG	Regenerative Contactor	VRA	Drive Accel Variable Resistor
		MP	Pump Contactor (For old type)		
DS_{FO}	Forward Optional Direction Switch	MR	Reverse Contactor	VRAP	Pump Variable Resistor
		OPT	Option	VRB	Brake Variable Resistor
DS_R	Reverse Direction Switch	O/S	Oversize	W/	With
		PB_{CPU}	Computer print Board		

OPERATIONAL TIPS

1. Safe operation
   (1) After jacking up, always support with rigid stands.

   (2) When hoisting the vehicle or its heavy component, use wire rope(s) with a sufficient reserve in load capacity.

   (3) Always disconnect the battery plugs before the inspection or servicing of electrical parts.

2. Protection of functional parts
   (1) After the end of vehicle inspection and/or maintenance, carefully check each connector for perfect connection without ommission before connecting the battery plug.
   Ommission of connection of any connector related to the controller, especially, may cause damage of controller internal elements.

3. Tactful operation
   (1) Prepare the mechanic tools, necessary measuring instruments (circuit tester, megger, oil pressure gage, etc.) and SSTs before starting operation.

   (2) Before disconnecting wiring, always check the cable color and wiring state.

   (3) When overhauling functional parts, complicated portions or related mechanisms, arrange the parts neatly to prevent confusion.

   (4) When disassembling and inspecting such a precision part as the control valve, use clean tools and operate in a clean location.

   (5) Follow the described procedures for disassembly, inspection and reassembly.

   (6) Replace gaskets, packings and O-rings with new ones each time of disassembly.

   (7) Use genuine Toyota parts for replacement.

   (8) Use specified bolts and nuts. Observe the specified tightening torque at the time of reassembly. If no tightening torque is specified, tighten the bolt or nut according to the standard tightening torque table.

4. Grasping the trouble state
   When a trouble occurs, do not attempt immediate disassembly or replacement but first check if the trouble requires disassembly or replacement for correction.

CIRCUIT TESTER

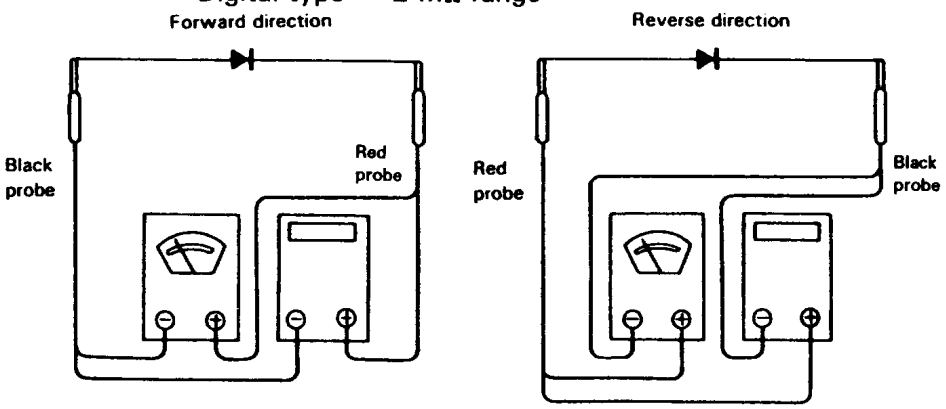
Circuit testers are available in both the analog and digital types. They should be used selectively according to the purpose of measurement.

Analog type: This type is convenient for observing movement during operation, but the measured value should only be used for reference or rough judgment.

Digital type: Fairly accurate reading is possible, but it is difficult to observe the variation or movement.

1. Difference between measurement results with the digital type and analog type
   * The result may be different between measurements with the analog type and digital type. Always use a circuit tester according to its operation manual. Cautions when the polarities are different between the analog type and digital type are described below.

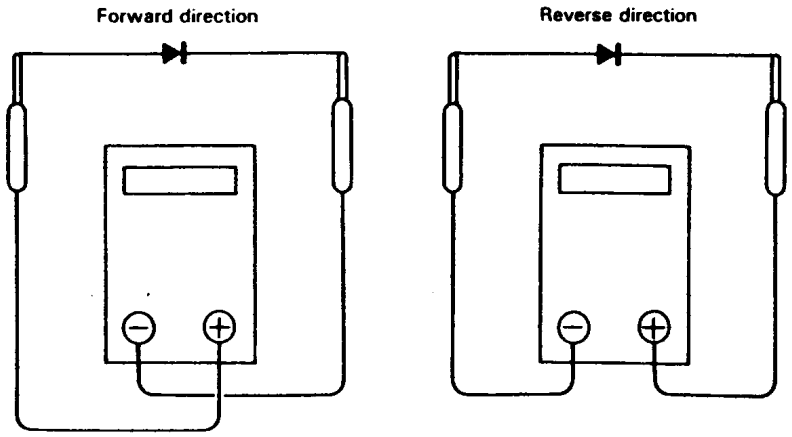
Circuit tester range: Analog type → KΩ range
Digital type → 2 MΩ range



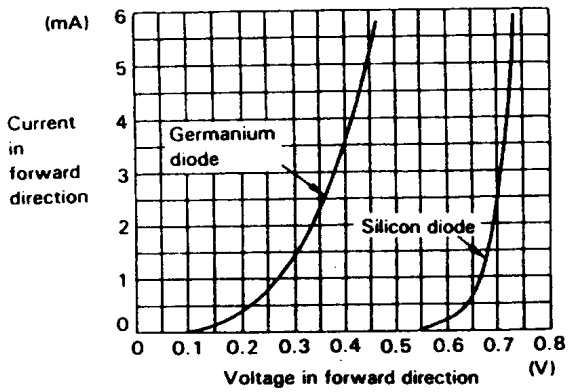
Measurement result example

	Analog type	Digital type
Forward	Continuity shall exist	No continuity
	11 KΩ	1
Reverse	No continuity	Continuity shall exist
	∞	2 MΩ

As seen from the example above, the measurement results with the analog and digital types are reverse. In measurement with a digital type circuit tester, therefore, use the tester probes as shown below.



2. Difference in result of measurement with circuit tester
The circuit tester power supply voltage depends on the tester type. 1.5V, 3.0V or 6.0V is used. The resistance of a semiconductor such as a diode varies with the circuit tester power supply voltage.
The diode characteristics are shown in the figure below.

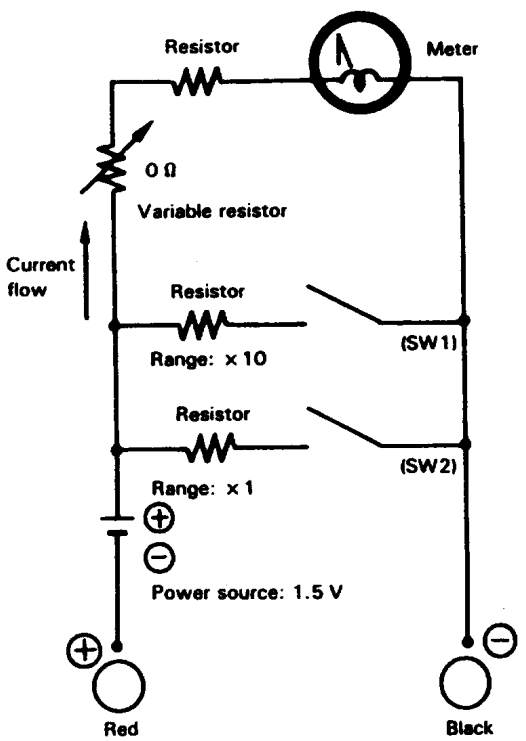


The resistance values of the same semiconductor measured with two types of circuit testers having different power supply voltages are different.

This manual describes the results of measurement with a circuit tester whose power supply voltage is 3.0 V.

3. Difference in measurement result by measurement range (analog type)
In the analog type circuit tester, changing the measurement range switches over the internal circuit to vary the circuit resistance. Even when the same diode is measured, the measurement result varies with the measurement range.

Always use the range described in the repair manual for measurement.



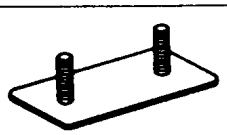
STANDARD BOLT & NUT TIGHTENING TORQUE

Standard bolt and tightening torques are not indicated.
Judge the standard tightening torque as shown below.

1. Find out the type of the bolt from the list below and then find the bolt tightening torque from the table.
2. The nut tightening torque can be judged from the mating bolt type.

BOLT STRENGTH TYPE IDENTIFICATION METHOD

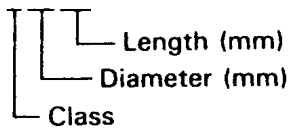
1. Indentification by bolt shape

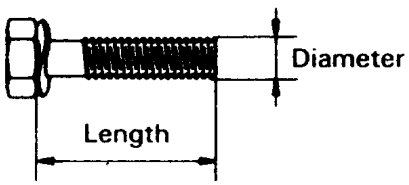
	Shape and class	Class
Hexagon head bolt	 Bolt head No.	4 = 4T 5 = 5T 6 = 6T 7 = 7T 8 = 8T
	 No mark	4T
Hexagon flange bolt	 No mark	4T
Hexagon head bolt	 Two protruding lines	5T
Hexagon flange bolt	 Two protruding lines	6T
Hexagon head bolt	 Three protruding lines	7T
Hexagon head bolt	 Four protruding lines	8T
Welded bolt		4T
Stud bolt	 No mark	4T
	 Grooved	6T

2. Identification by part No.

Hexagon head bolt

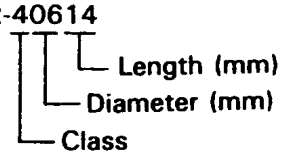
Parts No.
91611-40625

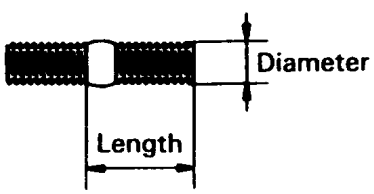




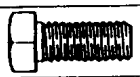
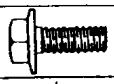
Stud bolt

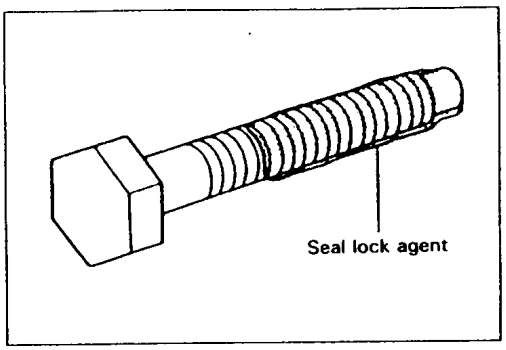
Part No.
92132-40614





TIGHTENING TORQUE TABLE

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt 			Hexagon flange bolt 		
			N·m	kgf-cm	ft-lbf	N·m	kgf-cm	ft-lbf
4T	6	1.0	5.4	55	48 in-lbf	5.9	60	52 in-lbf
	8	1.25	13	130	9	14	145	10
	10	1.25	25	260	19	28	290	21
	12	1.25	47	480	35	53	540	39
	14	1.5	75	760	55	83	850	61
	16	1.5	113	1150	83	—	—	—
5T	6	1.0	6.4	65	56 in-lbf	7.5	75	65 in-lbf
	8	1.25	16	160	12	18	175	13
	10	1.25	32	330	24	36	360	26
	12	1.25	59	600	43	65	670	48
	14	1.5	91	930	67	100	1050	76
	16	1.5	137	1400	101	157	1600	116
6T	6	1.0	7.8	80	69 in-lbf	8.8	90	78 in-lbf
	8	1.25	19	195	14	21	215	16
	10	1.25	38	400	29	43	440	32
	12	1.25	72	730	53	79	810	59
	14	1.5	110	1100	80	123	1250	90
	16	1.5	170	1750	127	191	1950	141
7T	6	1.0	11	110	8	12	120	9
	8	1.25	25	260	19	28	290	21
	10	1.25	52	530	38	58	590	43
	12	1.25	95	970	70	103	1050	76
	14	1.5	147	1500	108	167	1700	123
	16	1.5	226	2300	166	—	—	—
8T	6	1.0	12	125	9	14	145	9
	8	1.25	29	300	22	32	330	24
	10	1.25	61	620	45	68	690	50
	12	1.25	108	1100	80	123	1250	90
	14	1.5	172	1750	127	196	2000	145
	16	1.5	265	2700	195	299	3050	221



PRECOAT BOLTS

(Bolts with seal lock agent coating on threads)

1. Do not use the precoat bolt as it is in either of the following cases.
   (a) After it is removed.
   (b) When the precoat bolt is moved (loosened or tightened) by tightness check, etc.

Note:
For torque check, use the lower limit of the allowable tightening torque range. If the bolt moves, retighten it according to the steps below.

2. Method for reuse of precoat bolts
   (1) Wash the bolt and threaded hole. (The threaded hole must be washed even for replacement of the bolt.)
   (2) Perfectly dry the washed parts by air blowing.
   (3) Coat the specified seal lock agent to the threaded portion of the bolt.

HIGH PRESSURE HOSE FITTING TIGHTENING TORQUE

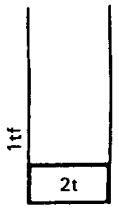
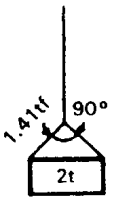
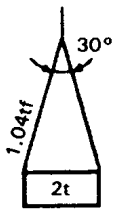
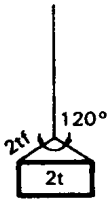
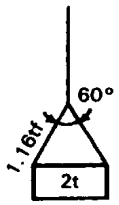
1. When connecting a high pressure hose, wipe the hose fitting and mating nipple contact surfaces with clean cloth to remove foreign matters and dirt. Also check no dent or other damage on the contact surfaces before installation.

2. When connecting a high pressure hose, hold the hose to align the fitting with the nipple and tighten the fitting.

3. The maximum tightening torque must not exceed twice the standard tightening torque.

Nominal diameter of screw	Standard tightening torque N·m (kgf-cm) [ft-lbf]		Hose inside diameter mm (in)
	Standard	Tightening range	
7/16 – 20UNF	25 (250) [18.1]	24~26 (240~270) [17.4~19.5]	6 (0.24)
9/16 – 18UNF	49 (500) [36.2]	47~52 (480~530) [34.7~38.3]	9 (0.35)
3/4 – 16UNF	59 (600) [43.4]	56~62 (570~630) [41.2~45.6]	12 (0.47)
7/8 – 14UNF	59 (600) [43.4]	56~62 (570~630) [41.2~45.6]	12 (0.47)
7/8 – 14UNF	78 (800) [57.9]	74~82 (760~840) [55.0~60.8]	15 (0.59)
1.1/16 – 12UNF	118 (1200) [86.8]	112~123 (1140~1250) [82.5~90.4]	19 (0.75)
1.5/16 – 12UNF	137 (1400) [101.3]	130~144 (1330~1470) [96.2~106.4]	25 (0.98)
PF1/4	25 (250) [18.1]	24~26 (240~270) [17.4~19.5]	6 (0.24)
PF3/8	49 (500) [36.2]	47~52 (480~530) [34.7~38.3]	9 (0.35)
PF1/2	59 (600) [43.4]	56~62 (570~630) [41.2~45.6]	12 (0.47)
PF3/4	118 (1200) [86.8]	112~123 (1140~1250) [82.5~90.4]	19 (0.75)
PF1	137 (1400) [101.3]	130~144 (1330~1470) [96.2~106.4]	25 (0.98)

WIRE ROPE SUSPENSION ANGLE LIST

Suspension angle	Tension	Compression	Suspension method	Suspension angle	Tension	Compression	Suspension method
0°	1.00 time	0 time		90°	1.41 time	1.00 time	
30°	1.04 time	0.27 time		120°	2.00 time	1.73 time	
60°	1.16 time	0.58 time					

SAFE LOAD FOR EACH WIRE ROPE SUSPENSION ANGLE Unit: N (tonf) [lbf]

Rope diameter	Cutting load	Single-rope suspension	Two-rope suspension				Four-rope suspension			
		0°	0°	30°	60°	90°	0°	30°	60°	90°
6 mm (0.24 in)	21380 (2.18) [4807]	3040 (0.31) [683.6]	6080 (0.62) [1367]	5880 (0.6) [1323]	5200 (0.53) [1169]	4310 (0.44) [970]	12160 (1.24) [2734]	11770 (1.2) [2646]	10400 (1.06) [2337]	8630 (0.88) [1940]
8 mm (0.32 in)	31480 (3.21) [7078]	4410 (0.45) [992.3]	8830 (0.9) [1985]	8530 (0.87) [1918]	7650 (0.78) [1720]	6280 (0.64) [1411]	17650 (1.8) [3969]	17060 (1.74) [3937]	15300 (1.56) [3440]	12550 (1.28) [2322]
10 mm (0.4 in)	49230 (5.02) [11069]	6960 (0.71) [1565.6]	14020 (1.43) [3153]	13440 (1.37) [3021]	11770 (1.2) [2646]	9810 (1.0) [2205]	27460 (2.8) [6174]	26480 (2.7) [5954]	23540 (2.4) [5292]	19610 (2.0) [4410]
12.5 mm (0.5 in)	76880 (7.84) [17387]	10980 (1.12) [2469.5]	21570 (2.2) [4851]	21280 (2.1) [4631]	18630 (1.9) [4190]	14710 (1.5) [3308]	43150 (4.4) [9702]	41190 (4.2) [9261]	37270 (3.8) [8379]	29420 (3.0) [6615]
14 mm (0.56 in)	96400 (9.83) [21675]	13730 (1.4) [3087]	27460 (2.8) [6174]	26480 (2.7) [5954]	23540 (2.4) [5292]	18630 (1.9) [4190]	54920 (5.6) [12348]	52960 (5.4) [11907]	47070 (4.8) [10584]	37270 (3.8) [8379]

COMPONENTS WEIGHT

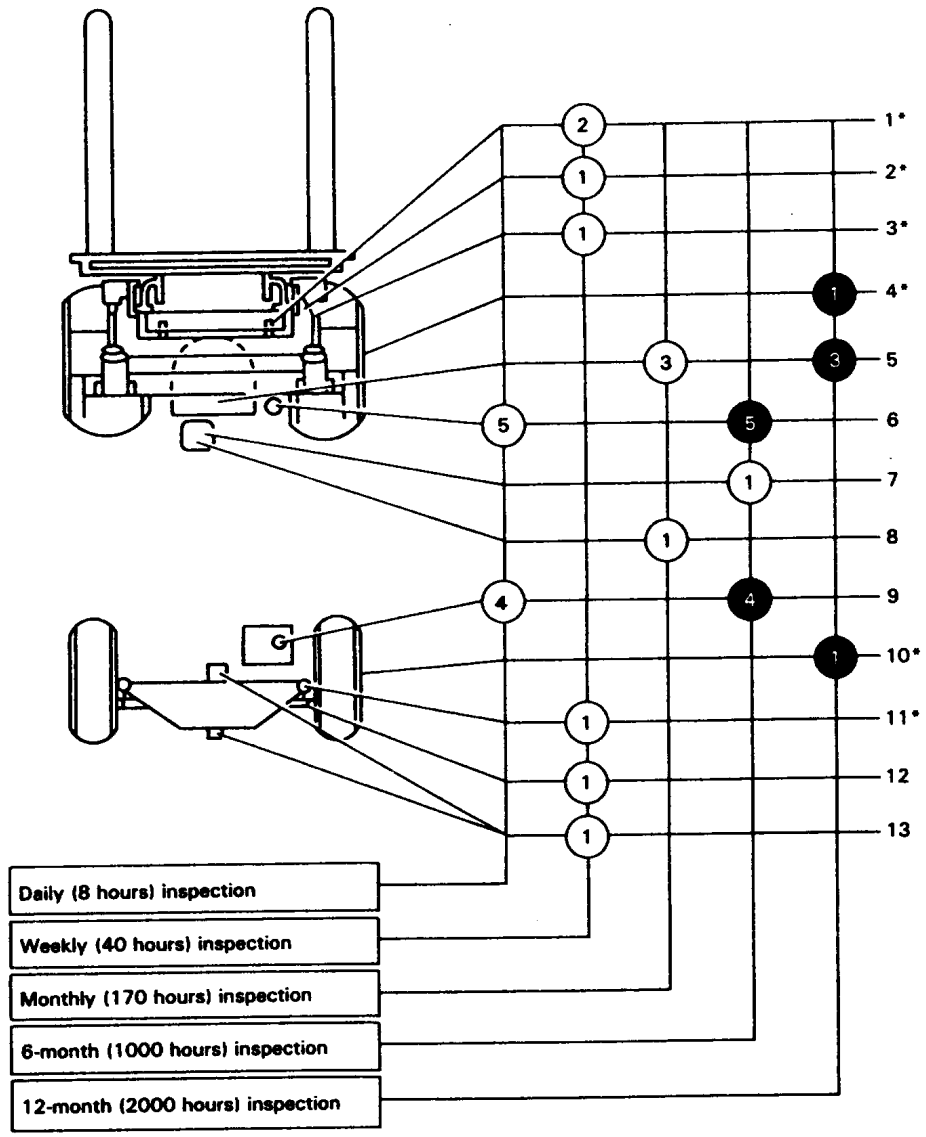
Unit: kg (lb)

Component \ Model	FBMF16	FBMF20·25	FBMF30
Total weight (L/battery)	2230 (4910)	20: 2510 (5520) 25: 2840 (6250)	3380 (7440)
Drive motor	81 (179)	114 (251)	114 (251)
Pump motor	63.5 (140.0)	70.5 (155.4)	73 (161.0)
Drive unit ASSY (L/motor)	Approx. 235 (518)	Approx. 275 (606)	Approx. 295 (650)
Counter weight	408 (900)	20: 434 (957) 25: 772 (1702)	972 (2143)
V mast ASSY W/lift bracket (W/lift cylinder, L/fork Max. lifting height: 3300 mm (130 in))	460 (1014)	520 (1147)	630 (1389)

RECOMMENDED LUBRICANTS AND CAPACITIES

Application	Class	Model	Capacity
Differential & drive unit	API GL-4 or 5	Hypoid gear oil (SAE 85W-90)	5.5 ℓ (1.45 US gal)
Hydraulic oil	ISO VG-32	Hydraulic oil	22.5 ℓ (5.94 US gal)
Brake line	——	SAE J-1703 DOT-3	Proper quantity
Chassis parts	——	MP grease No. 2	Proper quantity
Battery electrolyte	——	Distilled water	Proper quantity

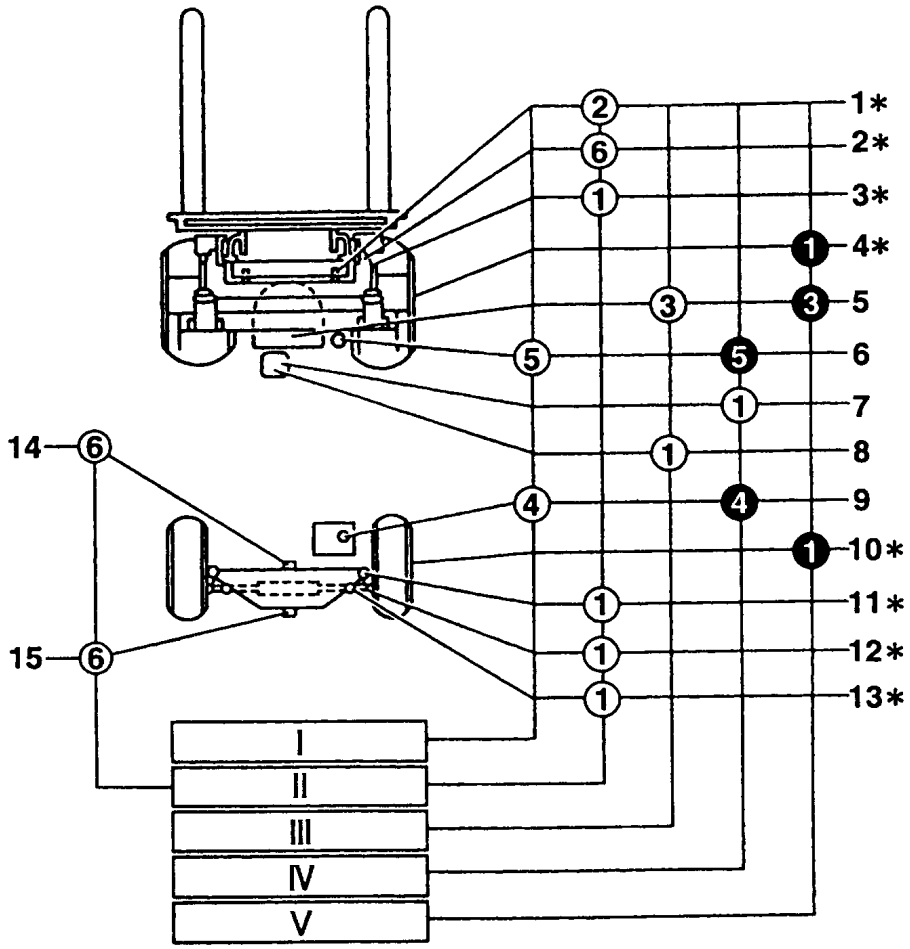
LUBLICATION CHART (Up to May 1999)



- ● MP grease
- ● Engine oil
- ● Hypoid gear oil
- ● Hydraulic oil
- ● Brake fluid
- *: Both RH & LH
- ◌: Inspection
- ●: Replacement

1 Chain
2 Mast support busing
3 Tilt cylinder front pin
4 Front wheel bearing
5 Differential & drive unit
6 Brake fluid reservoir tank
7 Tilt steering locking mechanism
8 Tilt steering universal joint
9 Oil tank
10 Rear wheel bearing
11 Steering knuckle king pin
12 Rear axle beam, front
13 Rear axle beam, rear

LUBRICATION CHART (From June 1999)



1. Chain
2. Mast support bushing
3. Tilt cylinder front pin
4. Front wheel bearing
5. Differential & drive unit
6. Brake fluid reservoir tank
7. Tilt steering locking mechanism
8. Tilt steering universal joint
9. Oil tank
10. Rear wheel bealing
11. Steering knuckle king pin
12. Tie rod end pin
13. Rear axle cylinder end pin
14. Rear axle beam front pin
15. Rear axle beam rear pin

*: Located on right and left sides

I Inspect every 8 hours (daily)
II Inspect every 40 hours (weekly)
III Inspect every 170 hours (monthly)
IV Inspect every 1000 hours (6 monthly)
V Inspect every 2000 hours (annually)
O Inspect and service
● Replace

① MP grease
② Engine oil
③ Hypoid gear oil
④ Hydraulic oil
⑤ Brake fluid
⑥ Molybdenum disulfide grease

PERIODIC MAINTENANCE

INSPECTION METHOD

I : Inspection·Repair or replacement if required.
M: Measurement·Repair or adjustment if required.
T : Retightening C: Cleaning L: Lubrication
* : For new vehicle *1: Flaw detector

Item \ Inspection Period		Every month	Every 3 months	Every 6 months	Every 12 months
		Every 170 hours	Every 500 hours	Every 1000 hours	Every 2000 hours
ELECTRICAL SYSTEM					
Motor	Rotation sound	I	←	←	←
	Looseness in connecting parts	T	←	←	←
	Insulation resistance		M	←	←
	Brush wear and sliding condition			I	←
	Commutator contamination, damage			I	←
	Brush, spring wear				M
Battery	Charging level	I	←	←	←
	Electrolyte level	I	←	←	←
	Electrolyte specific gravity	M	←	←	←
	Terminal looseness	I	←	←	←
	Abnormality in the upper portion of battery case	I	←	←	←
	Insulation resistance		M	←	←
	Voltage measurement of each battery cell after charging				M
Magnet contactor	Contact looseness, damage, abrasion	I	←	←	←
	Operating condition of contamination or abrasion the auxiliary contact	I	←	←	←
	Mounting condition of the arc shooter				I
	Operating condition and timing				I
	Looseness of coil mounting parts				I
	Mounting condition or looseness of main circuit lead wire				I
Microswitch	Operating condition and timing	I	←	←	←
	Damage and looseness of installing parts	I	←	←	←
Direction switch	Operation condition, damage	I	←	←	←

Item	Inspection Period	Every month Every 170 hours	Every 3 months Every 500 hours	Every 6 months Every 1000 hours	Every 12 months Every 2000 hours
Controller	Operation condition	I	←	←	←
	Interior contamination, damage	C	←	←	←
	Overcurrent limit value				M
Fuse	Looseness	I	←	←	←
Wiring (including charging cord)	Harness deterioration, clamp damage and looseness	I	←	←	←
	Looseness in connecting parts, taping condition	I	←	←	←
	Connecting condition and damage of the battery connector	I	←	←	←
POWER TRANSFER SYSTEM					
Differential Transmission	Oil leakage	I	←	←	←
	Oil level	I	←	←	←
	Bolt or nut loosenss				T
RUNNING EQUIPMENT					
Wheels	Tire air pressure	M	←	←	←
	Tire cuts, damage and uneven treads	I	←	←	←
	Loose rim and hub nuts	T	←	←	←
	Tread depth	M	←	←	←
	Metal fragments, stones or other foreign objects in tires	I	←	←	←
	Rim, side ring and disc wheel damage	I	←	←	←
	Front wheel bearing unusual noise and looseness	I	←	←	←
	Rear wheel bearing unusual noise and looseness	I	←	←	←
Front axle	Housing cracks and damage				I
Rear axle	Beam cracks, damage and deformation				I
	Axle beam looseness in forward and backward direction	M*			M

Item \ Inspection Period		Every month / Every 170 hours	Every 3 months / Every 500 hours	Every 6 months / Every 1000 hours	Every 12 months / Every 2000 hours
STEERING SYSTEM					
Steering wheel	Play and looseness	I	←	←	←
	Operating condition	I	←	←	←
Gear box	Oil leakage	I	←	←	←
	Mounting looseness	T	←	←	←
	Clogging of relief valve filter			C	←
Rods, links and arm	Wear, looseness and damage	I	←	←	←
	Linkage wear and mounting condition				I
Power steering	Oil leakage	I	←	←	←
	Mounting and linkage looseness	I	←	←	←
	Power steering hose damage				I
Knuckle	King pin looseness	I	←	←	←
	Cracking and deformation				I
Steering wheel shaft	Wheel alignment				M
	Left and right turning angle				M
BRAKING SYSTEM					
Brake pedal	Play and reserve	M	←	←	←
	Braking effect	I	←	←	←
Parking brake	Pull margin	I	←	←	←
	Braking effect	I	←	←	←
	Rod and cable looseness and damage	I	←	←	←
	Ratchet wear and damage				I
Brake pipe and hose	Leakage, damage, and mounting condition	I	←	←	←
Brake oil	Level	I	←	←	←
Master cylinder or brake valve and wheel cylinder	Function, wear, damage, mounting looseness				I
Brake drum and brake shoes	Clearance between drum and lining	M	←	←	←
	Shoe sliding position and lining wear				I
	Drum wear and damage				I
	Operating condition of the shoe				I
	Rust on the anchor pin				I
	Return spring wear				M
	Function of the automatic control system				I
Backing plate	Deformation, crack, damage				I
	Looseness in mounting parts				T

Item \ Inspection Period		Every month / Every 170 hours	Every 3 months / Every 500 hours	Every 6 months / Every 1000 hours	Every 12 months / Every 2000 hours
LOAD HANDLING SYSTEM					
Forks	Fork and stopper pin condition	I	←	←	←
	Left and right fork uniformity	I	←	←	←
	Cracks in fork base and welded portion				I*1
Mast and lift bracket	Deformation, damage and cracks in welded portion	I	←	←	←
	Mast and lift bracket looseness	I	←	←	←
	Mast support bushing wear and damage				I
	Roller wear, damage and rotating condition	I	←	←	←
	Roller pin wear and damage				I
	Mast strip wear and damage	I	←	←	←
Chain and chain wheel	Chain tension, deformation and damage	I	←	←	←
	Chain lubrication	I	←	←	←
	Chain anchor bolt condition	I	←	←	←
	Chain wheel wear, damage and rotating condition	I	←	←	←
Various attachments	Abnormalities and mounting condition	I	←	←	←
HYDRAULIC SYSTEM					
Cylinder	Cylinder mounting looseness and damage	T	←	←	←
	Deformation or damage of rod, rod screw and rod end	I	←	←	←
	Cylinder operation	I	←	←	←
	Natural drop and natural forward tilt	M	←	←	←
	Oil leakage and damage	I	←	←	←
	Wear and damage of pin and cylinder shaft support	I	←	←	←
	Lifting speed	M	←	←	←
	Uneven movement	I	←	←	←
Oil pump	Oil leakage and unusual noise	I	←	←	←
Hydraulic oil tank	Oil level and contamination	I	←	←	←
	Tank and oil strainer			C	←
	Oil leakage	I	←	←	←

Item \ Inspection Period		Every month / Every 170 hours	Every 3 months / Every 500 hours	Every 6 months / Every 1000 hours	Every 12 months / Every 2000 hours
Control lever	Linkage looseness	I	←	←	←
	Operation	I	←	←	←
Oil control valve	Oil leakage	I	←	←	←
	Relief pressure measurement				M
	Relief valve and tilt lock valve function	I	←	←	←
Hydraulic piping	Oil leakage	I	←	←	←
	Deformation and damage	I	←	←	←
	Linkage looseness	T	←	←	←
SAFETY DEVICES, ETC.					
Head guard	Welded part crack	I	←	←	←
	Deterioration, damage	I	←	←	←
Back rest	Looseness in mounting parts	T	←	←	←
	Deterioration, crack, damage	I	←	←	←
Lighting system	Operation, mounting condition	I	←	←	←
Horn	Operation, mounting condition	I	←	←	←
Turn signal	Operation, mounting condition	I	←	←	←
Instruments	Operation	I	←	←	←
Reversing alarm	Operation, mounting condition	I	←	←	←
Rear view mirror	Contamination, damage	I	←	←	←
	Reflection	I	←	←	←
Seat	Mounting looseness, damage	I	←	←	←
Body	Damage or cracking of frame, cross member, etc.				I
	Bolts and nuts looseness				T
Others	Lubrication	L	←	←	←

PERIODIC REPLACEMENT OF PARTS AND LUBRICANTS

Replacement shall be made upon arrival of the operation hours or months, whichever is earlier.

Replacement timing / Item	Every month / Every 170 hours	Every 3 months / Every 500 hours	Every 6 months / Every 1000 hours	Every 12 months / Every 2000 hours
Brake fluid			●	←
Hydraulic oil			●	←
Hydraulic oil filter	● (New vehicle)		●	←
Differential and drive unit oil				●
Wheel bearing grease				●
Master cylinder rubber parts				●
Wheel cylinder rubber parts				●
Reserve tank tube				●
Power steering hose	Every 2 years			
Internal rubber parts of power steering system	Every 2 years			
Hydraulic hoses	Every 2 years			
Chains	Every 3 years			

Totaldokument

Toyota FBMF 16-30

Var 250:e timme

Pos	Kontroll av:
0:0	**Grupp 0 Hel maskin**
0:1	Dörrar/luckor
0:2	Motviktsinfästning
0:3	Förarskydd/hytt
0:4	Batterilåsning
0:5	Skyltar/dekaler
0:6	Förarmiljö
0:7	Stol/mattor
0:8	Pedalgummin
0:9	Torkare/spolare
0:10	Provkörning test av samtliga funktioner
0:11	Smörjning enligt schema
1:0	**Grupp 1 Motorer**
1:1	Missljud
1:2	Fastsättning/infästning
2:0	**Grupp 2 Kraftöverföring**
2:1	Oljenivå
2:2	Fastsättning
3:0	**Grupp 3 Bromsar/hjul**
3:1	Däck/hjul
3:2	Lufttryck däck
3:3	Hjulbultar/hjullager
3:4	Färdbroms, funktion/läckage
3:5	Parkeringsbroms
3:6	Bromsvätskenivå
3:7	Pedallänkage/pedalspel
4:0	**Grupp 4 Styrning**
4:1	Styrlänkar, kontroll
4:2	Slangar/rör, läckage
4:3	Styraxel/upphängning
5:0	**Grupp 5 Elsystem**
5:1	Belysning/körriktningsvisare
5:2	Instrument/kontrollampor
5:3	Signalhorn
5:4	P-broms-/Backalarm
5:5	Timmätare, avläsning
5:6	Färdväljare
5:7	Kablar/anslutningar
5:8	Transistorpanel
5:9	Accelerationspedal/fartreglage
5:10	Microbrytare
5:11	Kontaktorer/kontakter
5:12	Säkringar
5:13	Batterivätskenivå
5:14	Batteri, smuts/läckage
5:15	Batterianslutningar
5:16	Batteripoler reng./infettning
5:17	Batterihandskar, kontroll
6:0	**Grupp 6 Hydraulik**
6:1	Slangar/rör, läckage
6:2	Ventilreglage/länkage
6:3	Andningsfilter/ventilatorer
6:4	Oljenivå
7:0	**Grupp 7 Arbetsfunktion**
7:1	Lyftstativ
7:2	Gafflar
7:3	Lyftkedjor
7:4	Laststöd
7:5	Lyft-/tiltcylindrar

Var 500:e timme tillkommer:

1:0	**Grupp 1 Motorer**
1:3	Drivmotor, renblåsning
1:4	Pumpmotor, renblåsning
1:5	Styrp. motor, renblåsning
1:6	Motorer, isolationsprov
5:0	**Grupp 5 Elsystem**
5:18	Batteri, isolationsprov

Var 1000:e timme tillkommer:

1:0	**Grupp 1 Motorer**
1:7	Drivmotorkol, kontroll
1:8	Pumpmotorkol, kontroll
1:9	Styrp.motorkol, kontroll
3:0	**Grupp 3 Bromsar/hjul**
3:8	Hjullager infettning
3:9	Bromsvätska byte
4:0	**Grupp 4 Styrning**
4:4	Slangar, kontroll
6:0	**Grupp 6 Hydraulik**
6:5	Hydraulolja, byte
6:6	Returfilter, byte
6:7	Sugfilter, rengöring/byte
6:8	Andningsfilter, reng./byte

Var 2000:e timme tillkommer:

0:0	**Grupp 0 Hel maskin**
0:12	Ram, kontroll av sprickor
0:13	Bultar/Muttrar, fastsättning
1:0	**Grupp 1 Motorer**
1:10	Kolfjädrar, styrka
2:0	**Grupp 2 Kraftöverföring**
2:3	Drivaxel, oljebyte
2:4	Drivaxel, fastsättn./sprickor
3:0	**Grupp 3 Bromsar/hjul**
3:10	Hjulbroms, slitagekontroll
5:0	**Grupp 5 Elsystem**
5:19	Batteribelastningsprov
5:20	Motorström, mätning
6:0	**Grupp 6 Hydraulik**
6:9	Hydraultryck, kontroll
7:0	**Grupp 7 Arbetsfunktion**
7:6	Gafflar, gaffeltest

DEVELOPMENT OBJECTIVES

DEVELOPMENT OBJECTIVES

The FBM16 to 30 counter-battery type forklifts were subject to new model in 1989. In January, 1994, minor change including mast ASSY change was made in addition to the full model change of the engine type forklifts. At the same time, the body color and logo were also changed to unify the image of Toyota industrial vehicles.
In the economic environment changing rapidly in recent years, however, we have improved the following points for increasing the market share by overcoming the competition with other manufacturers:

1. Improved dwelling ability
   - Standard adoption of suspension seat
   - Increased head clearance

2. Improved operability
   - Adoption of small diameter steering wheel
   - Adoption of seat switch

3. Improved instrument panel visibility
   - Adoption of two-spoke steering wheel

4. Improved market suitability
   - Installation of DIN battery case
   - Standard adoption of pneumatic shaped cushion tires

We believe that the new models will be accepted by much more customers by their superiority to competing products through improvements to make them better match the market needs.

FEATURES (SELLING POINTS)

List of Selling Points

Selling point	Means	Objective	Applicable models	Page
Higher job handling capability				
Long operation hours	Microcontroller MCS-Ⅱ			
	Material handling chopper	Energy saving	All models	—
	Regenerative braking interlocked with brake pedal operation			
	Switch back regenerative braking			
	Electronically controlled full hydraulic power steering	Reduction of fatigue and energy saving	All models	—
	Installation of large capacity battery	Energy saving	All models	—
Excellent mobility				
High material lifting speed	Low loss valve and piping	High lifting speed in the class	All models	—
Minimum fatigue				
Excellent operability	MCS-Ⅱ			
Refined control	No bypass contactor	Vehicle control as desired	All models	—
	Material handling chopper			
	Traveling hybrid control			
	Quick start			
	Antiroll-back			
	Material handling speed adjustment	Optimum material handling speed	Option	—
	2-speed travel speed adjustment	Optimum maximum speed setting	All models	—
Easy getting on and off	Open step	Reduction of fatigue in getting on and off	All models	2-10
	Assist grip			2-11
	Rounded corner at front end of battery hood			
	Round shaped head guard pillars			
Wide field of view	Low overall height of front protector	Improved field of view	All models	—
	Reduction of meter panel size			
	V mast as standard equipment	Wide front visibility	All models	2-13

Selling point	Means	Objective	Applicable models	Page
Minimum fatigue (Cont')				
Excellent operability / Easy operation	Regenerative power brake	Reduction of brake pedal effort	All models	2-9
	Electronically controlled full hydraulic power steering	Reduced fatigue	All models	—
	Material handling lever operating force	Excellent material handling operation efficiency	All models	—
Best driving position	Optimized dimensions around operator's seat	• Reduced fatigue • Higher degree of freedom in driving position	All models	2-8
	Small steering wheel diameter			
	Tilt steering with memory	Realization of best driving position	All models	2-11
	Suspension seat			
	Foot rest	Reduced fatigue and higher safety	All models	—
	Increased overall height	Enlarged head clearance	All models	—
	Extended wheel base	Enlarged floor space	All models	—
Noise reduction / Traveling noise	Low-speed high-torque driving motor	Lowest noise in the class	All models	—
	Drive unit helical gear			
	High-frequency traveling chopper	Elimination of chopper noise	All models	—
Material handling noise	Low-speed high-torque material handling motor	Lowest noise in the class	All models	—
	Double gear pump		FBMF16,20,25	2-23
	Floating piping and control valves		All models	—
MCS-Ⅱ	Temporary holding of traveling/material handling contactor	Reduction of contactor noise (clicking sound)	All models	—
	No bypass contactor			
Safety	Battery slip out prevention mechanism	Secure holding of battery case and cells	All models	2-4
	Lever type parking brake	Ensured braking force	All models	—
	Safety down valve	Prevention of quick fork fall	All models	—
	Flow regulator valve	Proper lowering speed	All models	—
	Integrally welded head guard	Sturdy head guard conforming to the standard	All models	—
	Duo servo brake with automatic adjuster	• Sure braking with light pedal effort • Constant braking travel	All models	—
	Sealed hydraulic tank cap by separate breather installation	• Prevention of hydraulic oil spouting • Easier hydraulic tank cap removal	All models	2-24
	Battery connector disconnecting device	Power disconnection in an emergency	All models	2-3

Selling point	Means	Objective	Applicable models	Page
Economy				
High reliability				
Battery life				
MCS-Ⅱ	Overdischarge warning function	Overdischarge prevention	All models	2-5
Motor brush life	Low-speed high-torque motor	Current reduction	All models	—
MCS-Ⅱ	Switch back regenerative braking	Current reduction	All models	—
Brake lining life				
MCS-Ⅱ	Regenerative power brake	Use of regenerative braking	All models	—
Contactor contact life				
MCS-Ⅱ	Traveling & material handling chopper	Current reduction	All models	—
Enriched controller protecting functions	Adoption of thermal protector			
	Overvoltage protecting function	Preventing damage under abnormal loading to controller	All models	—
	Battery voltage abnormality protecting function			
High serviceability				
Easier inspection operation	Front cover removal without tool			
	Rear cover removal without tool			
	Toe board removal without tool	Improved serviceability	All models	—
	Integration of accelerator link and toe board			
	Blown fuse warning	Clear indication of trouble location	All models	—
Easier battery inspection	One touch tilt steering unlocking	Improved serviceability	All models	—
	Full open battery hood with damper	Easier opening/closing operation	All models	2-11
Improved management device				
MCS-Ⅱ	Digital multi-display			
	Speedometer	Safe speed setting	All models	—
	Battery charge indicator	Battery management	All models	—
	Diagnosis	Indication of trouble location	All models	—
	Multiway hour meter	Management data recording	Option	—
	Multiway power control	Optimum performance selection	Option	—
	Built-in analyzer	Detection of trouble location and function check	All models	—
	5-digit hour meter	Recording of management data	All models	—

Selling point	Means	Objective	Applicable models	Page
Considerate design				
	4-lamp type winker lamp	Improved visibility from around the vehicle	Option	—
	Rectangular rearview mirror	Improved rear visibility	Option	—
	Jacking point provided in counterweight	Jacking up with a screw jack	All models	—
	Illuminated meter panel	Improved meter visibility (at night)	All models	—
	Integrally resin-molded dashboard	High quality appeal	All models	—
	Rectangular head lamps	Bright, non-rusting resin housing	Option	—

MAJOR DIFFERENCES FROM OLD MODELS

Item		New model (FBMF series)	Applicable model	Old models (FBM series)	Applicable model
Overall length (to front edge of fork) mm (in)		2075 (81.7)	FBMF16	2045 (80.5)	FBM16
		2235 (88.0)	FBMF20	2205 (86.8)	FBM20
		2255 (88.8)	FBMF25	2235 (88.0)	FBM25
		2480 (97.6)	FBMF30	2460 (96.9)	FBM30
Overall height (to top of head guard) mm (in)		2160 (85.0)	FBMF16	2110 (83.1)	FBM16
		2180 (85.8)	FBMF20	2130 (83.9)	FBM20
		2275 (89.6)	FBMF30	2225 (87.6)	FBM30
Wheelbase mm (in)		1360 (53.5)	FBMF16	1340 (56.3)	FBM16
		1505 (59.3)	FBMF20	1485 (58.5)	FBM20
		1650 (65.0)	FBMF30	1630 (64.2)	FBM30
Battery		Installation of DIN battery case possible	All models	Installation of DIN battery case impossible	All models
Steering		2-spoke small diameter steering wheel (360 mm (14.2 in))	All models	3-spoke steering wheel (380 mm (15.0 in))	All models
Tire	Pneumatic shaped cushion tire	Standard	All models	Option	All models
	Cushion tire	Not provided as an option	All models	Provided as an option	All models
	Double-tire	Not provided as an option	All models	Provided as an option	All models
Frame	Step height (open step) mm (in)	520 (20.5)	FBMF16	600 (23.6)	FBM16
		540 (21.3)	FBMF20	620 (24.4)	FBM20
		675 (26.6)	FBMF30	735 (28.9)	FBM30
	Head clearance mm (in)	1035 (40.7)	All models	1010 (39.8)	All models
Seat		Suspension seat	All models	Non suspension seat	All models
Mast		V3300 mm (130 in) as standard	All models	V3000 mm (118 in) as standard	All models
		SV mast not provided	All models	SV mast provided as an option	All models
Backrest		Option	All models	Standard	All models
Fork length mm (in)		800 (31.5)	FBMF16	1070 (42.1)	FBM16
		1000 (39.4)	FBMF20	↑	FBM20
		1000 (39.4)	FBMF30	↑	FBM30
Oil pump capacity		33.0 cc (2.01 in^3)	FBMF30	33.3 cc (2.03 in^3)	FBM30
Head lamp		Option	All models	Standard	All models

EXPLANATION

BATTERY

GENERAL

1. Battery Specifications

(1) The standard is without a battery.
When installing a battery, remove the plate for retaining the battery hood.
(2) The table below shows the list of applicable batteries.
Three manufacturers, VALTA, CHLORIDE and OLDHAM are selected.

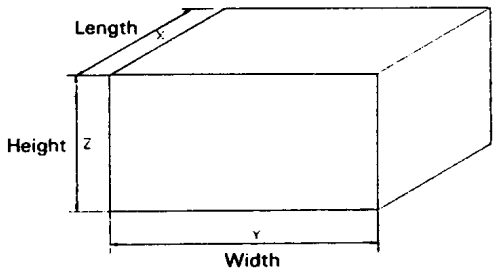
Applicable battery list (typical batteries only)

Vehicle model	Voltage	Applicable battery			Battery case		
					Inside dimensions mm (in)		
		Manufacturer	Type	Capacity (AH/5H)	Length	Width	Height
FBMF 16	72 80	VALTA	3P2S 360	360	1028 (40.47)	567 (22.32)	784 (30.87)
		↑	3P2S 450	450			
		CHLORIDE	HWFF7	360			
		↑	XWFF7	450			
		OLDHAM	CZQ TYPE3	360			
		↑	CZH TYPE3	450			
FBMF 20, 25	72 80	VALTA	4P2S 480	480	1028 (40.47)	711 (27.99)	784 (30.87)
		↑	4P2S 600HX	600			
		CHLORIDE	HWFF9	480			
		↑	XWFF9	600			
		OLDHAM	CZQ TYPE4	480			
		↑	CZH TYPE4	600			
FBMF 30	72 80	VALTA	5P2S 600	600	1028 (40.47)	855 (33.66)	784 (30.87)
		↑	5P2S 750HX	750			
		CHLORIDE	HWFF11	600			
		↑	XWFF11	750			
		OLDHAM	CZQ TYPE5	600			
		↑	CZH TYPE5	750			

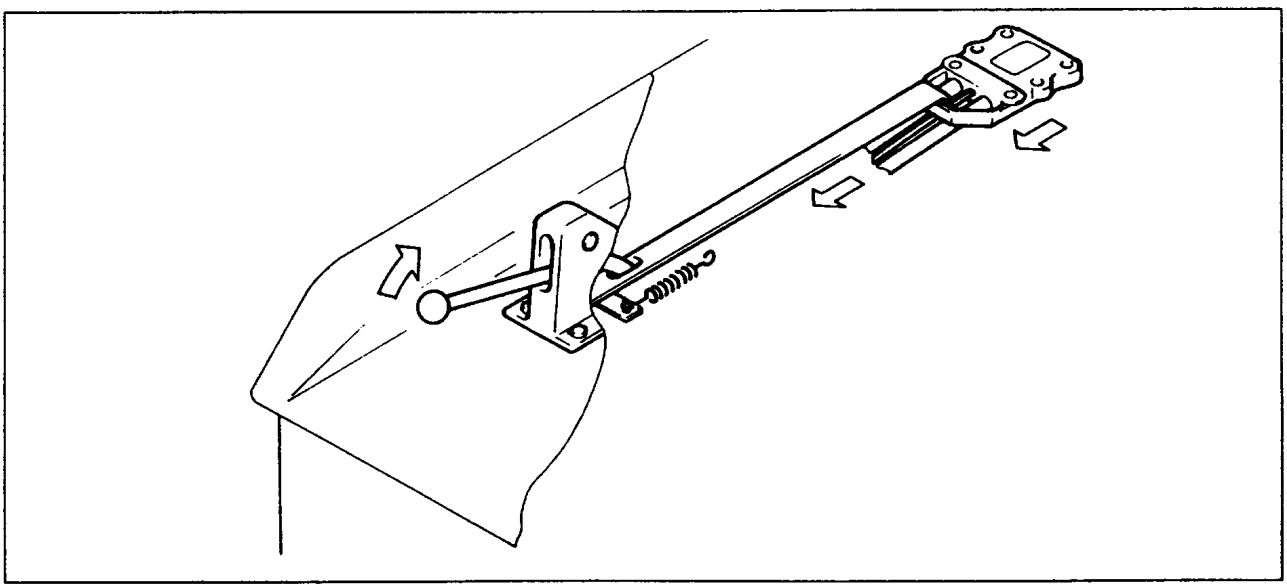
2. Battery compartment
When purchasing a battery locally, refer to the table below and adjust the weight to satisfy the minimum required weight without fail.

	Compartment dimensions mm (in)			Minimum required battery weight (with case) kg (lb)
	Length X	Width Y	Height Z	
FBMF 16	572 (22.52)	1,032 (40.63)	784 (30.9)	1,240 (89.7)
FBMF 20, 25	717 (28.23)	↑	↑	1,560 (112.8)
FBMF 30	862 (33.94)	↑	↑	1,865 (134.9)

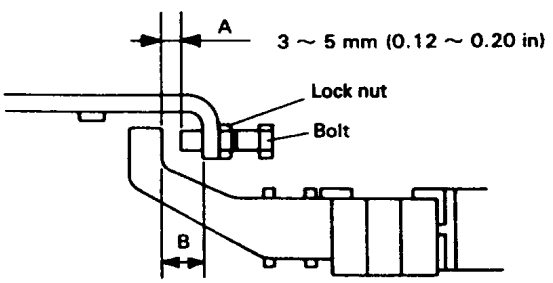
Battery compartment shape



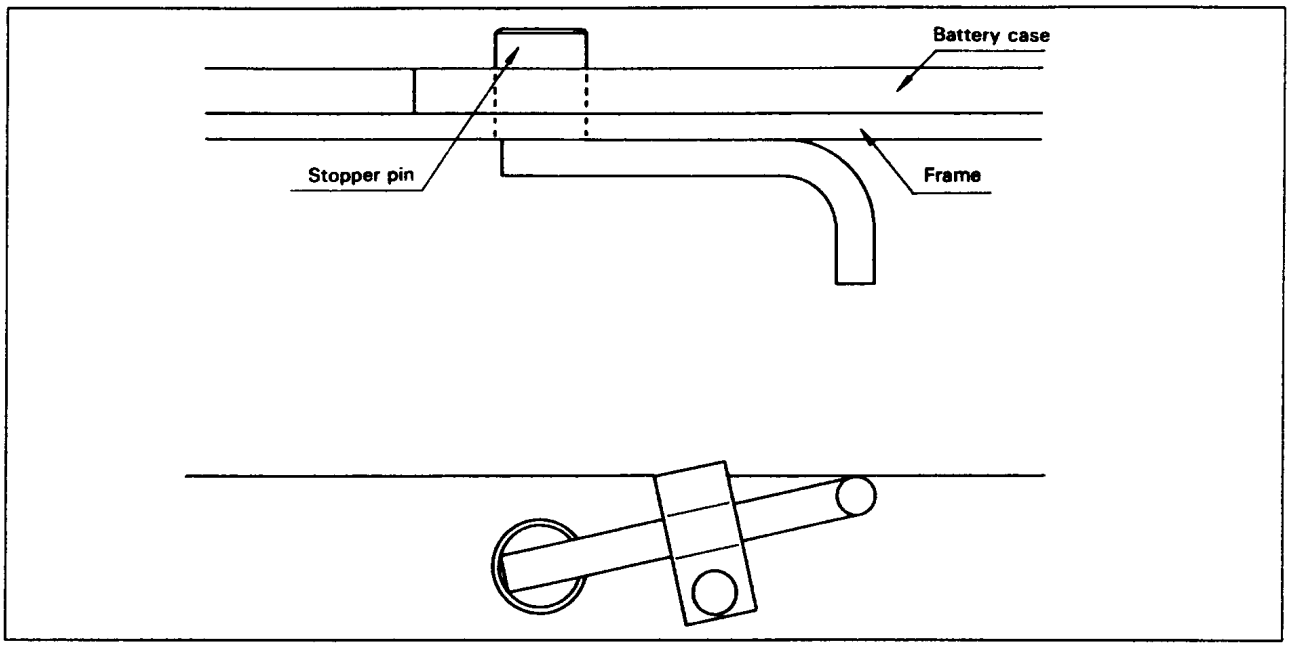
3. Battery disconnector
Though the battery connector needs connection and disconnection under the battery hood, it is possible to disconnect it by lever operation from the operator's seat in an emergency or at the time of charging.



* When the battery is installed locally, always see that the connector is disconnected by the release lever operation. If dimension B in the illustration below is excessive, install an M8 bolt to adjust dimension A to 3 to 5 mm (0.12 to 0.20 in) and fix the position by tightening the lock nut (M8).



4. The battery stopeer successfully used in the conventional models such as 5FBE10 to 18 is adopted for safety in case of accidental rollover.

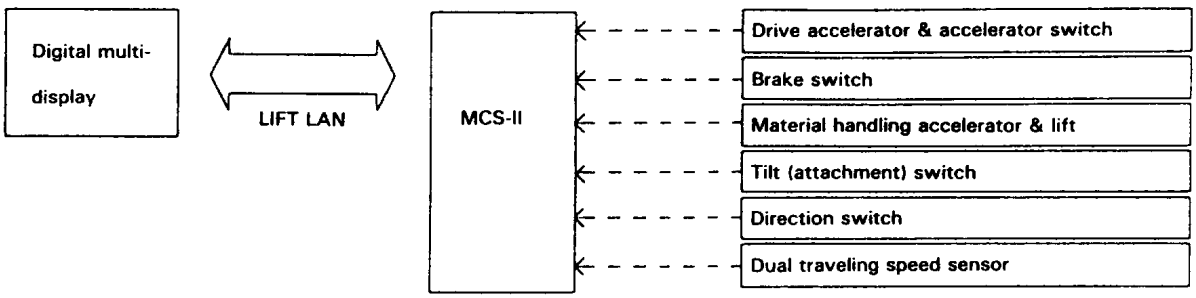


CONTROLLER

GENERAL

Basically the same as in the conventional models, but the system configuration has been changed because the brake potentiometer is replaced with a limit switch.
The lift interrupt function among major functions has also been modified.

System configuration



MAJOR FUNCTION

Lift Interrupt Function

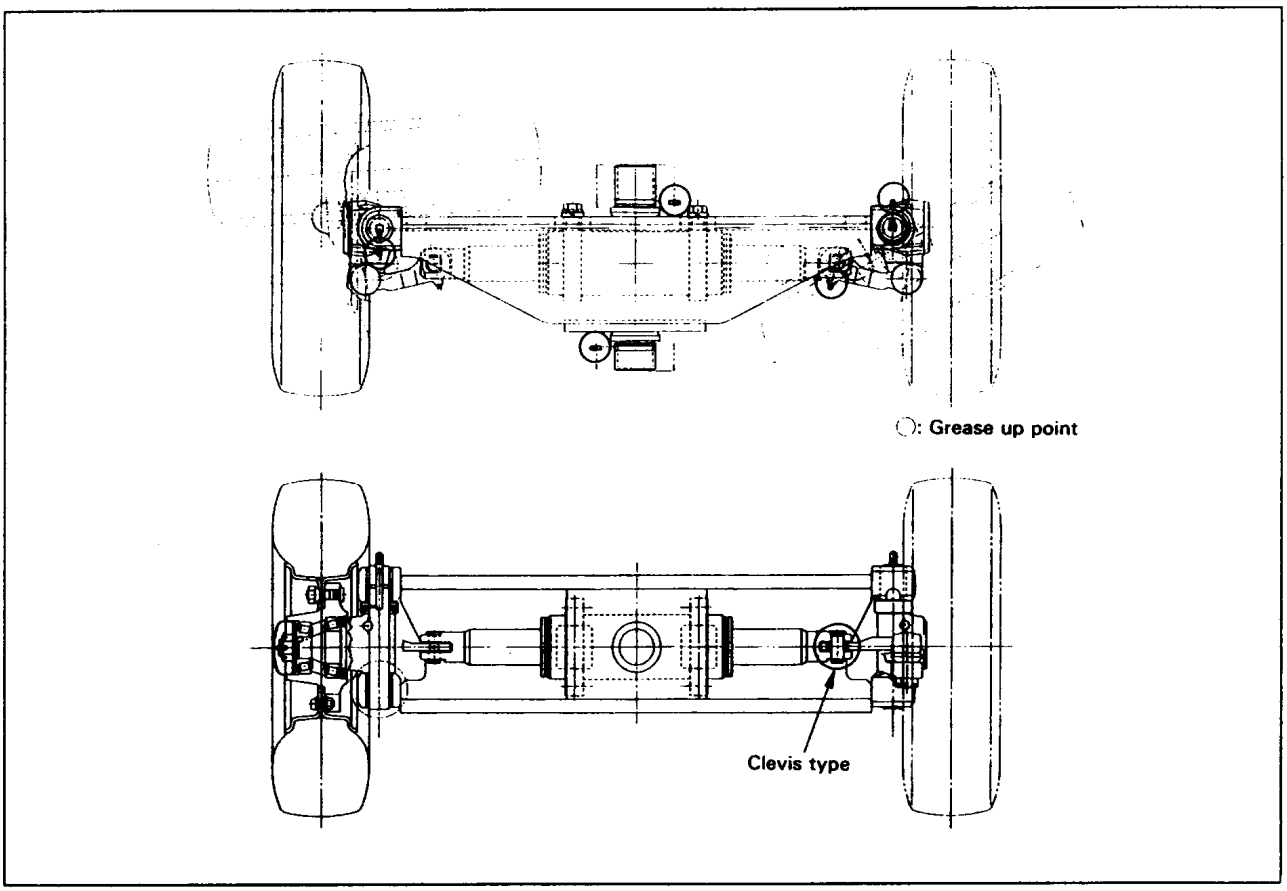
When the remaining battery charge decreases to the preset level, it is displayed on the multi-display to warn the operator to charge the battery and material handling operation is disabled to protect the battery.

- Material handling operation is disabled. (Operation for 30 seconds, however, is possible only once by setting the key switch to OFF once and to ON again.)
- The level can be set by MCS-II tuning (CA setting) as a display mask function.

CA setting level	1	2	3	4	5	6	7	8
Set value (remaining charge)	20 %	17 %	14 %	10 %	7 %	4 %	0 %	Warning fails

REAR AXLE

The rear axle is of the center-supported oscillating type as in the conventional models. Thanks to the two-point support at the front and rear, the rear axle is stabilized.



1. The rear axle allows grease up at all points in steered state to the left.
2. Since the tie rod and ball joint have been integrated, toe-in adjustment is unnecessary.
3. The joint between the PS cylinder and tie rod has been changed from the lock nut type to the clevis type.

WHEELS

GENERAL

1. The pneumatic shaped cushion (PSC) tires most frequently been installed on the conventional models are adopted as the standard tires, and pneumatic tires are adopted as options.
2. As in the conventional models, 23×9-10 is adopted as the front tire for the FBMF20 and 25. A wide tread specification is adopted for masts for high lifting heights.
3. Special low rolling resistance tires for battery forklifts are adopted exclusively as both front and rear tires as in the conventional models.
4. The sizes of standard tires are shown in the table below.

	Front tire	Rear tire
FBMF 16	21×8 - 9	5.00 - 8
FBMF 20, 25	23×9 -10	18 × 7-8
FBMF 30	28×9 -15	↑

Note:
- **Neither double nor cushion tires are provided.**
- **Long life pattern is not provided.**
- **7.00-12 for front and 6.00-9 for rear in the FBMF20 and 25 as well as 6.50-10 for rear in the FBMF30 are not provided.**

WHEEL LIST

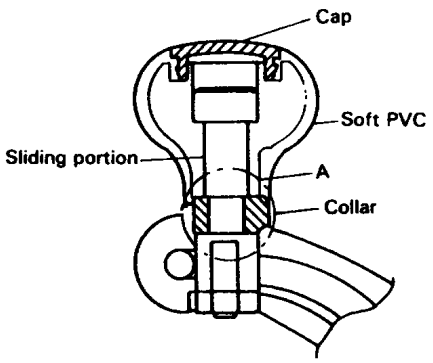
○: STD tire △: OPT tire

	Place		Pneumatic shaped cushion type			Pneumatic tire			
		Type	Tire size	Rim size	Applicability	Tire size	Inflating pressure	Rim size	Applicability
FBMF 16	Front tire	Standard	21×8-9	9×6.00E TB (Side ring)	○	21×8-9-14PR	880 kPa (9 kgf/cm²)[130 psi]	9×6.00E TB (Side ring)	△
		Oversize	6.50-10	10×5.00F TB (Side ring)	△	6.50-10-12PR	↑	10×5.00F TB (Side ring)	△
		Widetread	21×8-9	9×6.00E TB (Side ring)	△	21×8-9-14PR	↑	9×6.00E TB (Side ring)	△
	Rear tire		5.00×8	8×3.00D DT (Divided)	○	5.00-8-8PR	785 kPa (8 kgf/cm²)[115 psi]	8×3.00D DT (Divided)	△
				8×3.00D TB (Side ring)	△			8×3.00D TB (Side ring)	△
FBMF 20, 25	Front tire	Standard	23×9-10	10×6.50F TB (Side ring)	○	23×9-10-18PR	880 kPa (9 kgf/cm²)[130 psi]	10×6.5F TB (Side ring)	△
		Widetread	↑	↑	△	↑	↑	↑	△
	Rear tire		18×7-8	8×4.25 DT (Divided)	○	18×7-8-16PR	690 kPa (7 kgf/cm²) [100 psi]	8×4.25 DT (Divided)	△
				8×4.33 TB (Side ring)	△		880 kPa (9 kgf/cm²) [130 psi]	8×4.33 R TB (Side ring)	△
FBMF 30	Front tire	Standard	28×9-15	15×7.00T IR (Side ring)	○	28×9-15-14PR	785 kPa (8 kfg/cm²)[115 psi]	15×7.00S SDC (Side ring)	△
		Widetread	↑	↑	△	↑	↑	↑	△
	Rear tire		18×7-8	8×4.33R TB (Side ring)	○	18×7-8-16PR	880 kPa (9 kgf/cm²)[130 psi]	8×4.33R TB (Side ring)	△

STEERING

STEERING WHEEL

1. The steering wheel outside diameter is decreased from 380 mm (15.0 in) to 360 mm (14.2 in) for easier handling.
2. The number of spokes is decreased from three to two for light outlook and easier meter reading.
3. The surface is embossed for soft and high-grade appearance.
4. The knob position has been changed to ensure optimum driving position. The knob material remains unchanged for easy gripping.
5. The cap on top of the knob is of the same shielded type as in the conventional models. In new models, a collar is adopted at the bottom to prevent water accumulation in portion A.



BRAKE

GENERAL

The structure is basically the same as in the conventional models, but the brake for the 6FGF15 ~ 30 series is adopted for the FBMF16 and 30, and the wheel cylinder diameter is changed in the FBMF20, 25 for improving the main brake performance.

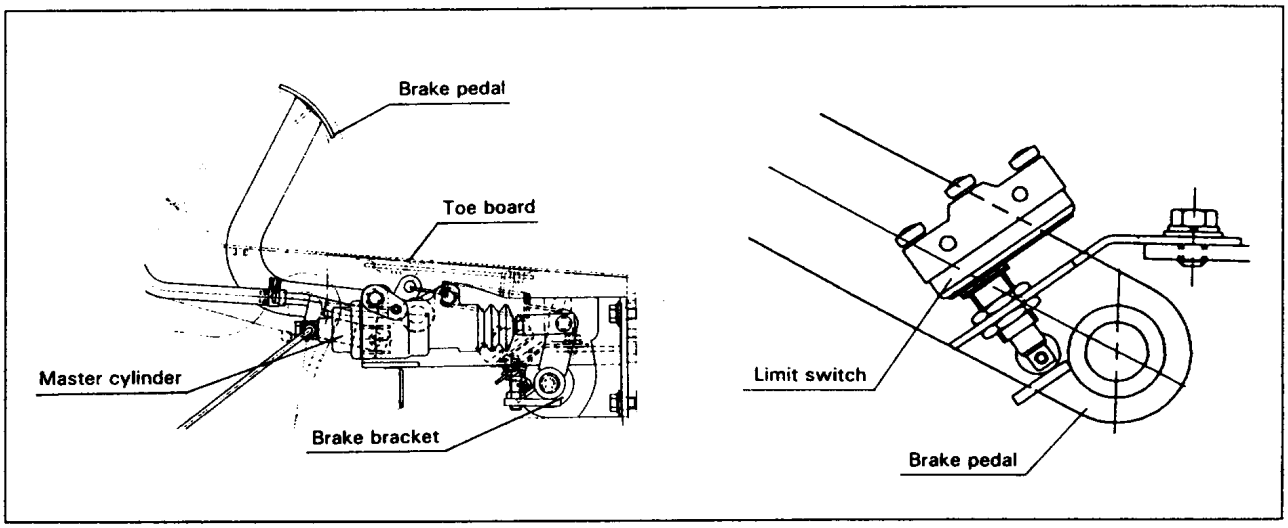
Brake specifications

		FBMF 16	FBMF 20, 25	FBMF 30
Type	Foot brake	Hydraulic, internal expanding, duo servo	←	←
	Parking brake	Internal expanding mechanical brake	←	←
Brake drum inside diameter mm (in)		254 (10.00)	279 (10.98)	310 (12.20)
Brake lining	Material	Resin mold (non-asbestos)	←	←
	Dimensions (length × width × thickness) mm (in)	279 × 48.5 × 4.9 (10.98 × 1.909 × 0.192)	302 × 55 × 5.1 (11.89 × 2.17 × 0.200)	343 × 60 × 7.0 (13.50 × 2.36 × 0.276)
	Area cm² (in²)	135 (20.9) × 2 pcs. × 2 wheels	166 (25.7) × 2 pcs. × 2 wheels	205 (31.8) × 2 pcs. × 2 wheels
Wheel cylinder bore mm (in)		22.2 (0.874)	25.4 (1.000)	28.5 (1.122)
Master cylinder bore mm (in)		19.05 (0.7500)	←	25.4 (1.000)
Applicable oil		SAE J-1703 DOT-3		

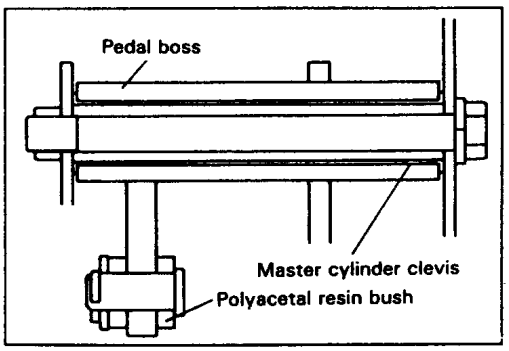
BRAKE PEDAL

1. The same step-on type pedal as in the conventional models is adopted as the brake pedal.

2. The regenerative brake sensor is changed from the rotary position sensor installed on the pedal shaft to a structure using a limit switch to improve the reliability and for easier regenerative brake readjustment.

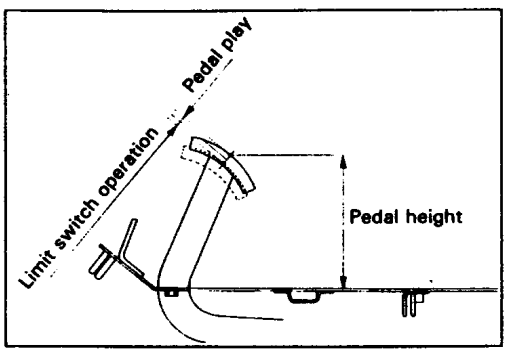


3. Polyacetal resin is used at link fulcrums, and the pedal boss diameter has been increased.



	Master boss outside diameter: A	Pedal boss outside diameter: B
Old model	25 (0.98)	15 (0.59)
New model	28 (1.10)	18 (0.71)

4. Pedal operation

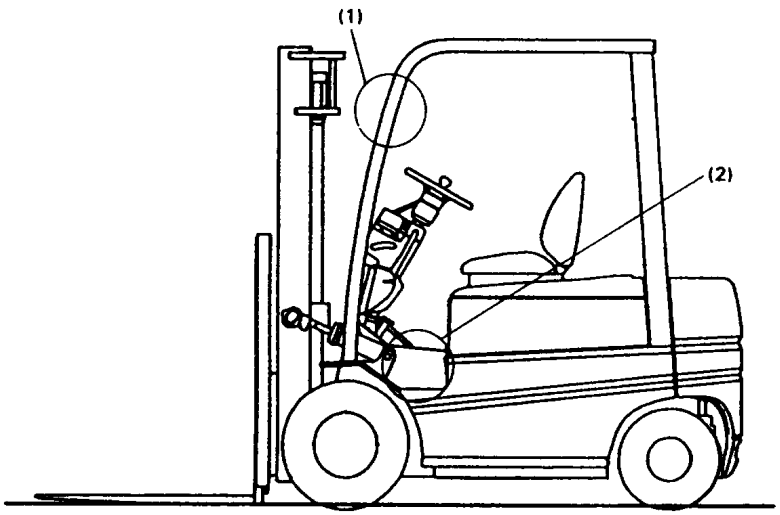


Pedal height (with pad): 134 ~ 139 mm (5.27 ~ 5.47 in)
Pedal play : 3 ~ 7 mm (0.12 ~ 0.28 in)
Start of regenerative brake application:
0 ~ 5 mm (0 ~ 0.20 in) from the end of pedal play

BODY FRAME

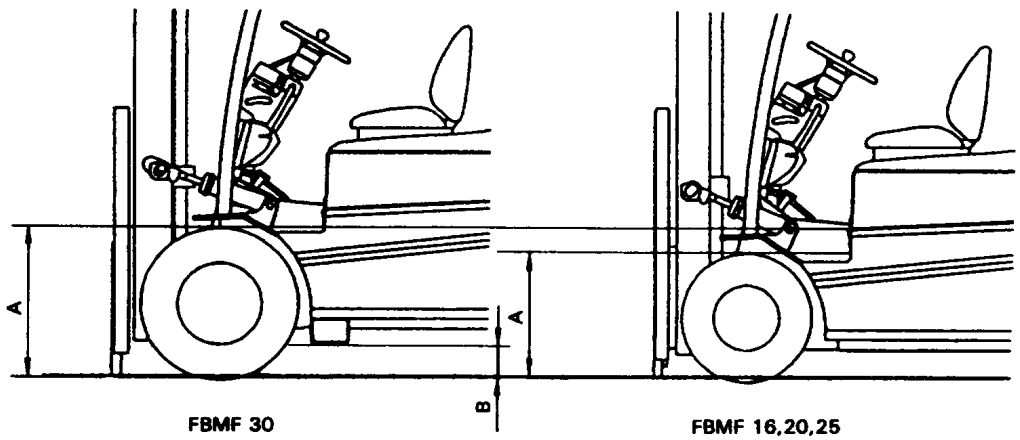
FEATURES OF BODY

1. The front pillar is curved with a large radius for easier getting on and off and better dwelling ability.
2. The open step height is lowered for easier getting on and off.



SUB-STEP

Since the open step height in the FBMF30 is above 550 mm (21.7 in) specified in the EEC standard, a sub-step aside from the open step is provided.



* EEC standard is 550 mm (21.7 in).

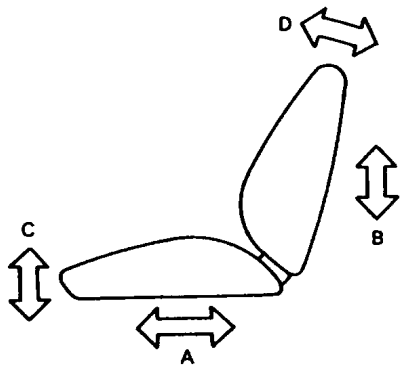
Models	A: Open step mm (in)	B: Sub-step mm (in)
FBMF 16	515 (20.28)	–
FBMF 20, 25	540 (21. 26)	–
FBMF 30	675 (26.57)	160 (6.30)

BATTERY HOOD

1. Battery hood
   The opening angle is increased from 84° to 88° for easier battery maintenance.

SEAT

A suspension seat with a seat switch (four-way adjustable seat) is adopted as the standard. A non-suspension seat, however, is adopted for ensuring sufficient head clearance in a vehicle with low overall height.



	Adjusting portion	Unit	Adjustable range
A	Seat slide	mm (in)	175 (6.89)
*B	Body weight adjustment Suspension stroke	kg (lb) mm (in)	50 ~ 120 (110 ~ 265) 50 (1.97)
C	Seat cushion tilt	deg.	3
D	Seat reclining	deg.	10

*: Suspension seat only

INSTRUMENTS

DIGITAL MULTI-DISPLAY

Display: General Function

Functions			All-round model	Easy model
Measuring functions	Speedometer		○	○
	Hour meter	Key-switch ON hour meter	○	○
		Lap time meter	○	–
		Traveling hour meter	○	–
		Material handling hour meter	○	–
		Odometer	○	–
		Trip meter	○	–
Status display functions	Battery charge indicator		○	○
	Power control	Traveling speed limiter level	○	○
		Traveling power control level	○	○
		Lift power control level	○	–
		Tilt power control level	○	–
	Traveling speed limiter set indicator		○	○
	Parking brake indicator		○	○
	Regeneration indicator		○	○
Warning functions	Battery overdischarge warning		○	○
	Blown fuse warning		○	○
	Overheat warning		○	○
	Digital diagnosis		○	○

Mask Functions

1. Though concurrent traveling and material handling operation is disabled on the vehicle before starting the hour meter, a demonstration mode function is added to allow it temporarily.
2. A battery function for correcting the battery charge meter is added for a battery whose discharge characteristic is different from that of the standard battery.

V MAST

GENERAL

The V mast is installed as the standard equipment.
The basic construction is the same as in the conventional models. Main improvements are as follows:

LIFT ROLLERS

Oversized rollers are provided for selection according to the mast to maintain the roller clearance in an optimum level.

mm (in)

FBMF 16, 20, 25	STD	107.7 (4.240)	O/S	108.7 (4.280)
FBMF 30	STD	119.7 (4.713)	O/S	120.7 (4.752)

MATERIAL HANDLING SPEED

Unit: mm/sec (fpm)

Models	Battery voltage (V)	Lifting speed		Lowering speed	
		Loaded	No-loaded	Loaded	No-loaded
FBMF 16	80	470 (93)	750 (147)	500 (98)	550 (108)
	72	420 (83)	600 (118)		
FBMF 20	80	440 (87)	600 (118)	↑	500 (98)
	72	400 (79)	550 (108)		
FBMF 25	80	420 (83)	600 (118)	↑	↑
	72	380 (75)	550 (108)		
FBMF 30	80	400 (79)	520 (102)	↑	↑
	72	360 (71)	470 (93)		

LOST LOAD CENTER (FROM CENTER OF FRONT AXLE TO FORK FRONT END)

Models	FBMF 16	FBMF 20, 25	FBMF 30
Lost load center mm (in)	405 (15.9)	420 (16.5)	485 (19.1)

FV MAST

GENERAL

The FV mast is provided as an option.
The basic structure is the same as in the conventional models. Main improvements are as follows:

LIFT ROLLERS

Same as in the case of the V mast.

MATERIAL HANDLING SPEED

Unit: mm/sec (fpm)

Models	Battery voltage (V)	Lifting speed		Lowering speed	
		Loaded	No-loaded	Loaded	No-loaded
FBMF 16	80	430 (85)	640 (126)	480 (94)	420 (83)
	72	390 (77)	560 (110)		
FBMF 20	80	410 (81)	540 (106)	↑	↑
	72	380 (75)	510 (100)		
FBMF 25	80	390 (77)	540 (106)	↑	↑
	72	360 (71)	510 (100)		
FBMF 30	80	290 (57)	440 (87)	460 (91)	390 (77)
	72	250 (49)	400 (79)		

LOST LOAD CENTER (FROM CENTER OF FRONT AXLE TO FORK FRONT END)

Same as in the case of the V mast.

FSV MAST

GENERAL

The FSV mast is provided as an option.
The basic structure is the same as in the conventional models. Main improvements are as follows:

LIFT ROLLERS

Same as in the case of the V mast.

MATERIAL HANDLING SPEED

Unit: mm/sec (fpm)

		FBMF 16	FBMF 20	FBMF 25	FBMF 30
Lowering speed	Loaded	480 (94)	←	←	460 (91)
	No-loaded	450 (89)	←	←	420 (83)

Lifting speed is the same as with the FV mast.

LOST LOAD CENTER (FROM CENTER OF FRONT AXLE TO FORK FRONT END)

Models		FBMF 16	FBMF 20, 25	FBMF 30
Lost load center	mm (in)	430 (16.9)	450 (17.7)	495 (19.5)

FORK & BACK REST

FORK

The fork size is changed.

	Fork thickness × width mm (in)
FBMF 16	80×40 (3.1×1.6)
FBMF 20, 25	100×40 (3.9×1.6)
FBMF 30	100×45 (3.9×1.8)

BACK REST

The flat steel back rest is provided as an option.

SERIES PARTS LIST

1. Fork bar and back rest

○: STD △: OPT

	Fork bar width (The overall back rest width is + 60 mm (2.4 in)) mm (in)					Back rest height mm (in)
	920 (36.2)	1020 (40.2)	1070 (42.1)	1170 (46.1)	1470 (57.9)	1220 (48.0)
FBMF 16	○	–	–	–	–	△
FBMF 20, 25	–	○	–	△	△	△
FBMF 30	–	–	○	△	△	△

2. Fork

○: STD △: OPT

	Fork length mm (in)					
	800 (31.5)	1000 (39.4)	1100 (43.3)	1200 (47.2)	1400 (55.1)	1500 (59.1)
FBMF 16	○	△	△	△	△	–
FBMF 20, 25	–	○	△	△	△	–
FBMF 30	–	○	△	△	△	△

MAST INTERCHANGEABILITY

1. Mast interchangeability in the same model

○: Interchangeable

	V → FV V → FSV	FV → V FV → FSV	FSV → V FSV → FV	Remarks
FBMF 16	○	○	○	The tilt cylinder and high pressure hose (control valve to cylinder) must be replaced when changing from FV or V to FSV or from FSV to FV or V.
FBMF 20, 25	○	○	○	
FBMF 30	○	○	○	

2. Interchangeability with 6FGF15, 20 and 30

○: Interchangeable

	V	FV	FSV
FBMF 16	○	○	○
FBMF 20, 25	–	–	–
FBMF 30	○	○	○

3. Installation of the masts for the FBM16 to 30 series on new models is possible for vehicles produced after Jan., 1994.
4. Installation of the masts for new vehicles on the FBM16 to 30 is possible for vehicles produced after Jan., 1994.
5. Fork interchangeability
   The forks are interchangeable as a set with the stopper pin. When the forks for a conventional model is required, order as a set of new forks and the stopper pin. (Old forks are not supplied.)
   It is possible to order only one fork, but it is recommended to order a set of two forks as far as possible because difference in heights at the tip ends of forks due to the wear of the other fork may arise.

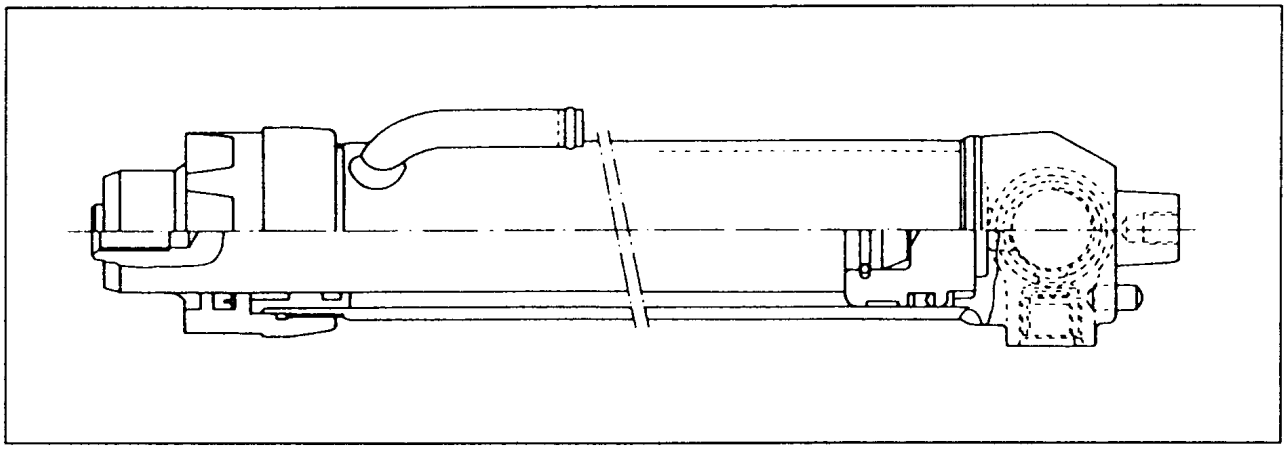
LIFT CYLINDER

GENERAL

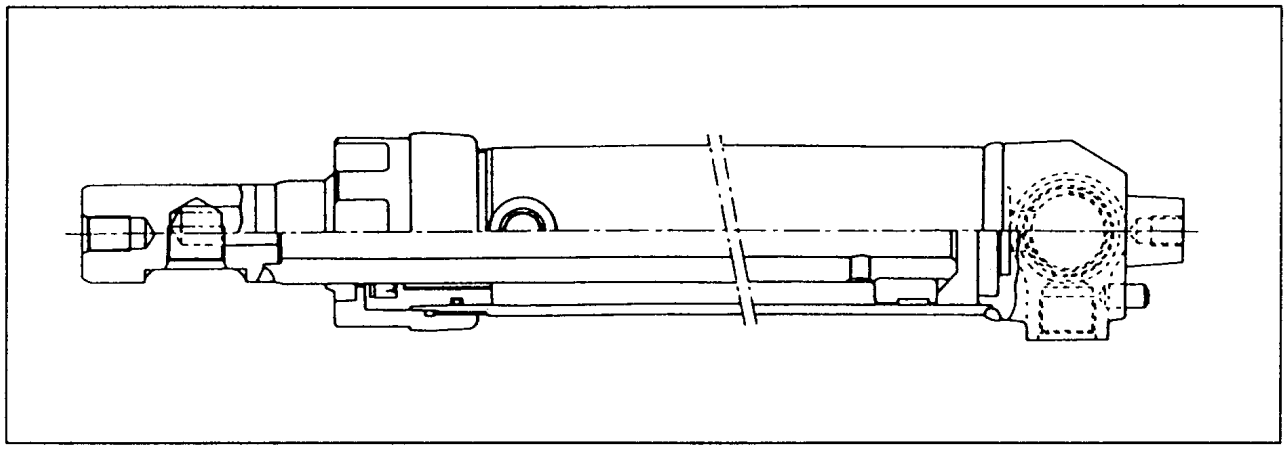
The basic structure is the same as in the conventional models.

LIFT CYLINDER (V mast) · REAR LIFT CYLINDER (FV & FSV mast)

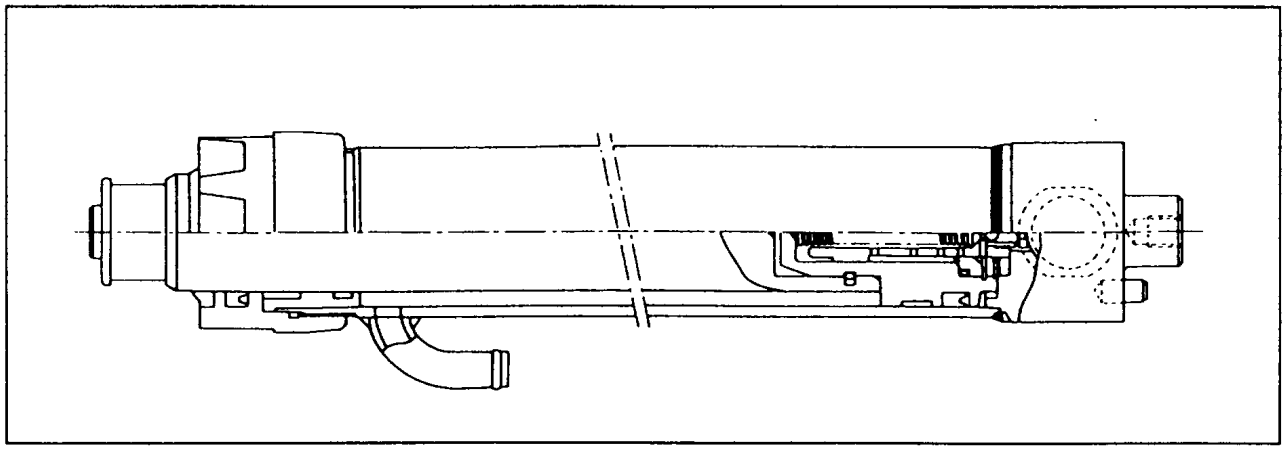
V Mast



FV Mast



FSV Mast



Specifications

1. Lift cyclinder (V)

Item \ Vehicle model		1 ton series	2 ton series	3 ton series
Lift cylinder type		Single acting type	←	←
Lift cylinder bore	mm (in)	45 (1.77)	50 (1.97)	55 (2.17)
Cylinder rod outside diameter	mm (in)	35 (1.38)	40 (1.57)	45 (1.77)
Piston seal type		U packing	←	←
Rod seal type		U packing	←	←
Others		With flow regulator valve (RH) With safety down valve (LH)	←	←

2. Rear lift cylinder (FV)

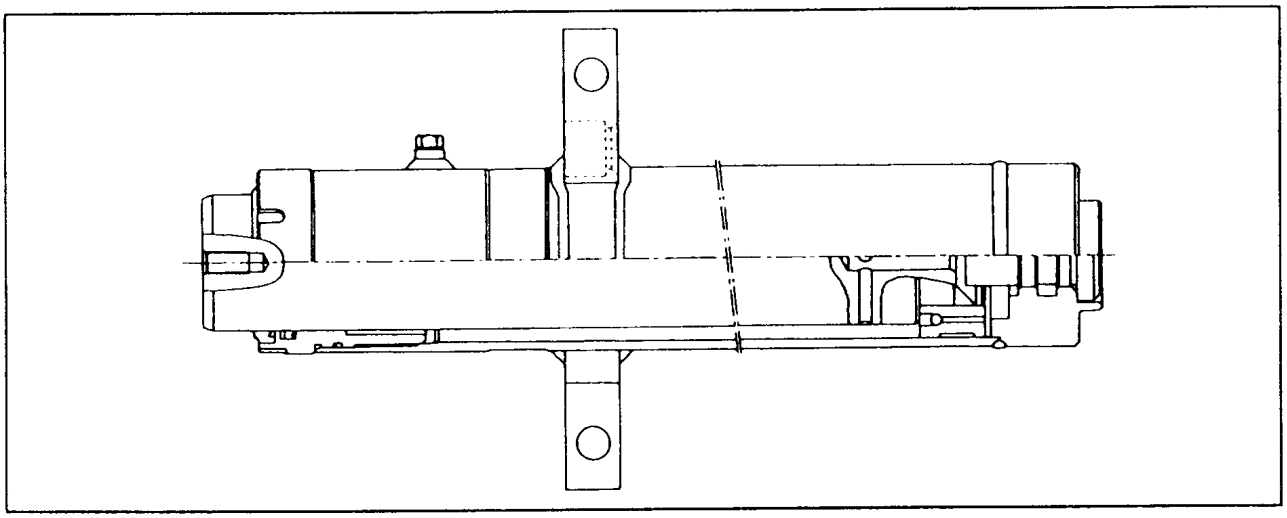
Item \ Vehicle model		1 ton series	2 ton series	3 ton series
Lift cylinder type		Single acting type	←	←
Lift cylinder bore	mm (in)	45 (1.77)	50 (1.97)	55 (2.17)
Cylinder rod outside diameter	mm (in)	32 (1.26)	35 (1.38)	40 (1.57)
Rod seal type		U packing	←	←
Others		With flow regulator valve (RH) With safety down valve (LH)	←	←

3. Rear lift cylinder (FSV)

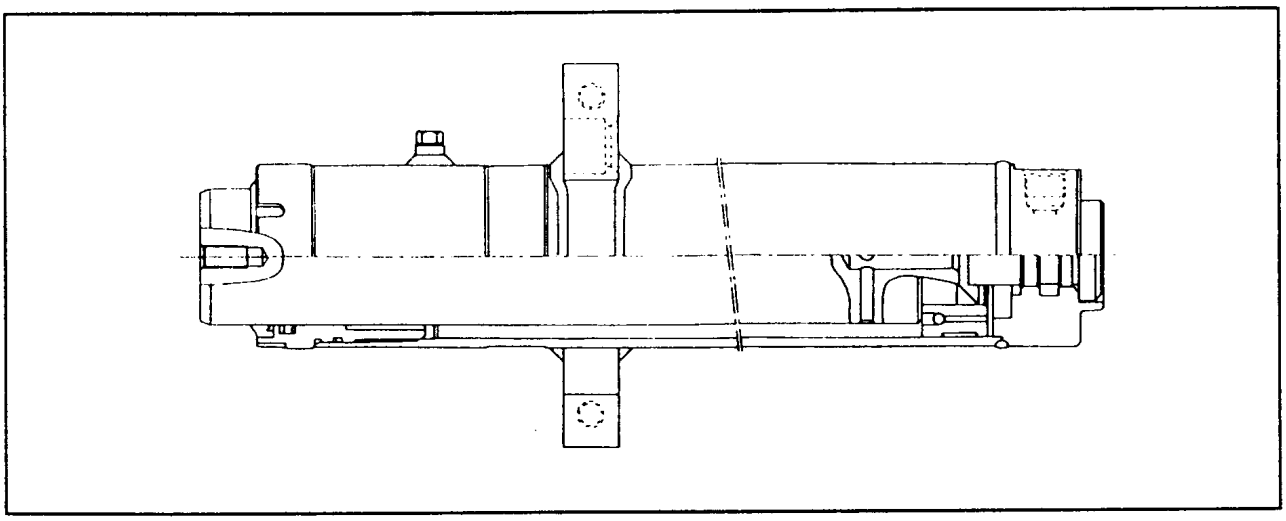
Item \ Vehicle model		1 ton series	2 ton series	3 ton series
Lift cylinder type		Single acting type	←	←
Lift cylinder bore	mm (in)	45 (1.77)	50 (1.97)	55 (2.17)
Cylinder rod outside diameter	mm (in)	35 (1.38)	40 (1.57)	45 (1.77)
Piston seal type		U packing	←	←
Rod seal type		U packing	←	←
Others		With safety down valve (RH)	←	←

FRONT LIFT CYLINDER (FV & FSV Mast)

FV Mast



FSV Mast



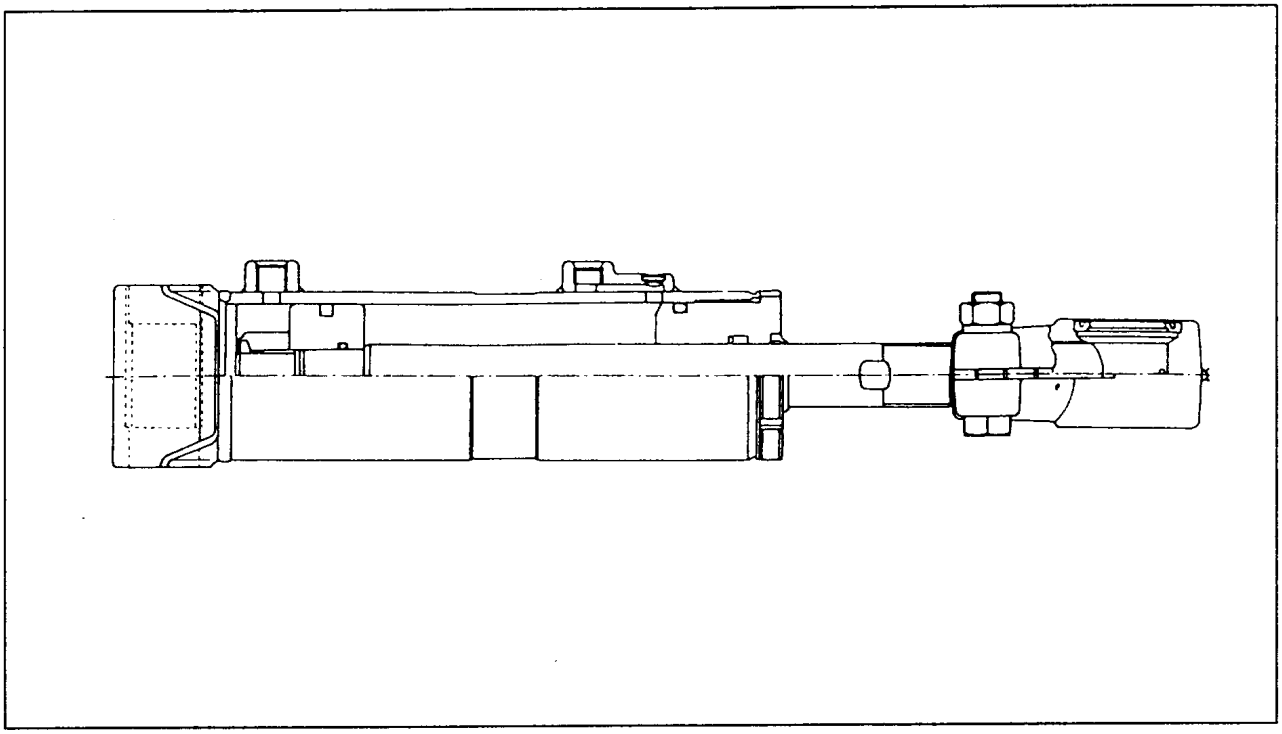
Specifications

Item \ Vehicle model		1 ton series	2 ton series	3 ton series
Lift cylinder type		Single acting type	←	←
Lift cylinder bore	mm (in)	85 (3.35)	90 (3.54)	105 (4.13)
Cylinder rod outside diameter	mm (in)	70 (2.76)	75 (2.95)	85 (3.35)
Piston seal type		Wear ring	←	←
Rod seal type		U packing	←	←
Others		With safety down valve	←	←

TILT CYLINDER

GENERAL

Two tilt cylinders are used, one on the right side and the other on the left side. Grease up is performed at the tilt joint pin on the mast side.
The structure is the same as in the conventional models.



Specifications

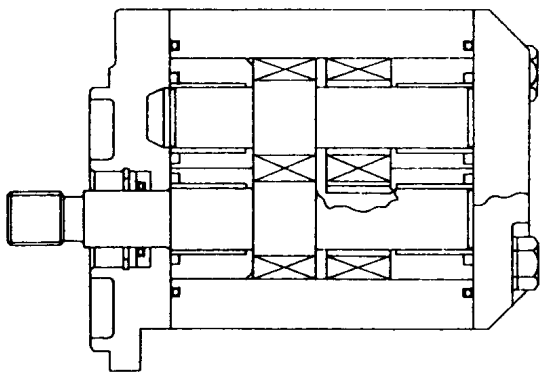
Item \ Vehicle model		All models
Number of tilt cylinders		2 pcs.
Tilt cylinder outside diameter	mm (in)	81.5 (3.209)
Tilt cylinder bore	mm (in)	70 (2.76)
Piston rod outside diameter	mm (in)	30 (1.18)
Piston stroke	mm (in)	143 (5.63)

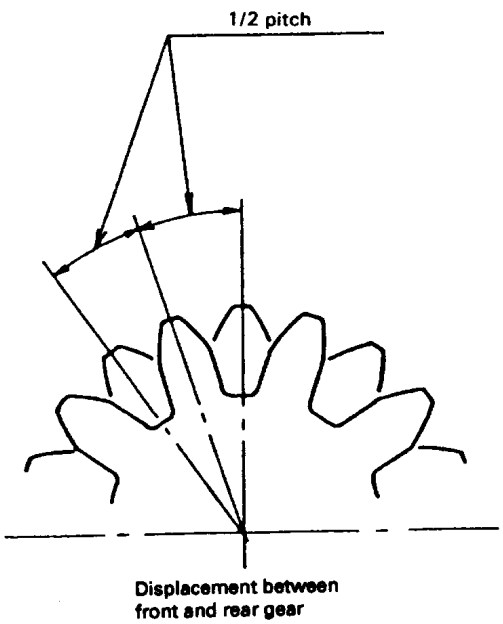
OIL PUMP

GENERAL

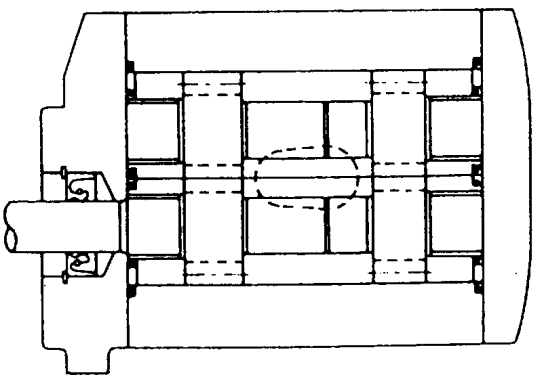
1. An external gear type oil pump is adopted.
2. Two types of oil pumps are used selectively as shown below.
   - FBMF 16, 20, 25:
     A double gear pump (phase-shift pump) is adopted to reduce hydraulic operation noise.
   - FBMF 30:
     A 12-teeth pulsating pump is adopted to reduce hydraulic operation noise.

FBMF 16

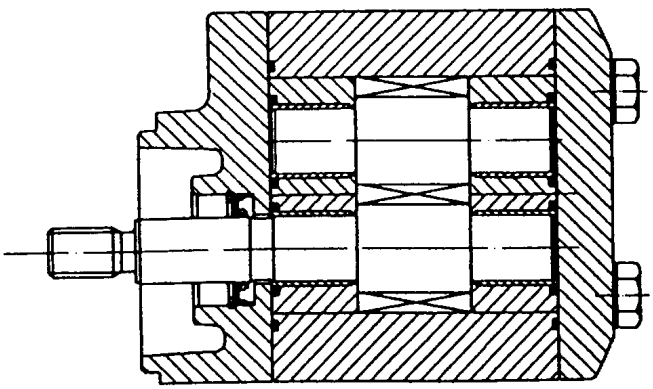




FBMF20 · 25



FBMF 30



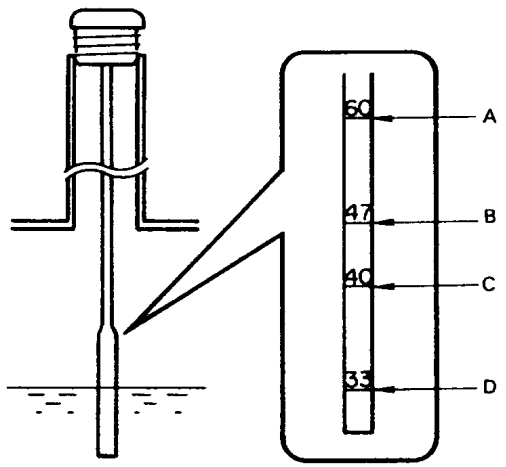
OIL PUMP SPECIFICATIONS

	FBMF 16	FBMF 20, 25	FBMF 30
Oil pump name	Gear pump (double gear)	←	Gear pump
Oil pump type	1SX250	DGP4-27	2PX330
Driving method	Driving by direct coupling with the motor		
Theoretical discharge rate cc/rev (in³/rev)	25.0 (1.53)	26.5 (1.617)	33.0 (2.014)

HYDRAULIC CIRCUIT

OIL TANK CAP

1. A rubber plug-in type cap is adopted in place of the plastic screw-in type on the conventional models for easy installation and removal.
2. Check the oil level with the cap fully inserted in the retainer inlet as illustrated below.



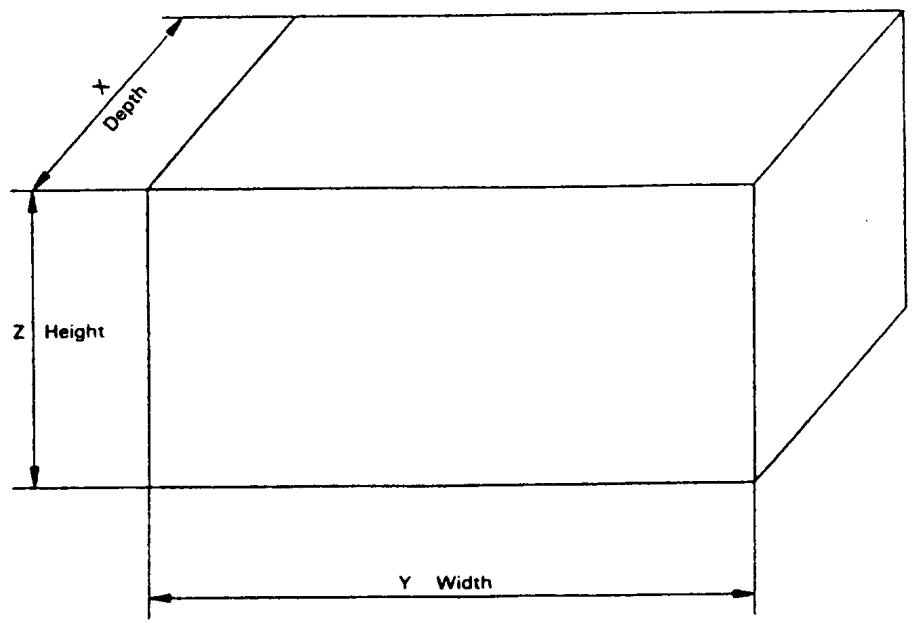
Lifting height mm (in)
A: 5500 ~ 6000 (217 ~ 236)
B: 4300 ~ 4700 (169 ~ 185)
C: 3500 ~ 4000 (138 ~ 157)
D: 3300 (130) or less

BATTERY

BATTERY COMPARTMENT AND REQUIRED WEIGHT

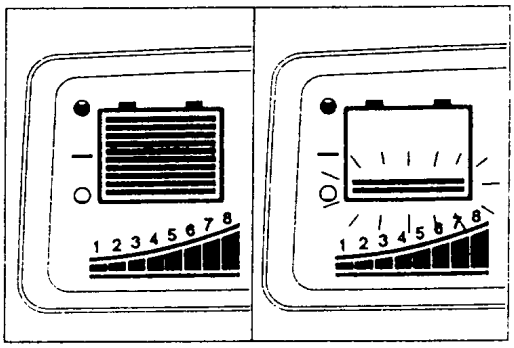
When the battery is to be purchased locally, always adjust the weight to satisfy the minimum required weight as shown in the table below.

Model	Compartment Dimensions mm (in)			Minimum required battery weight (with case) kg (lb)
	Depth X	Width Y	Height Z	
FBMF16	572 (22.5)	1032 (40.6)	784 (30.9)	1240 (2730)
FBMF20·25	717 (28.2)	↑	↑	1560 (3430)
FBMF30	862 (33.9)	↑	↑	1865 (4100)



SERVICE STANDARDS

Specific gravity upon perfect charging		1.280 [20°C (68°F)]
Specific gravity upon end of discharge		1.150 [20°C (68°F)]
Discharge end voltage	72/80 V	61/68 V
Electrolyte		Refined dilute sulfuric acid
Added fluid		Distilled (deionized) water
Insulation resistance		1 MΩ or more



Display Indication BARS73, 74

DISPLAY

BATTERY CAPACITY INDICATOR

The battery capacity indicator display indicates the charge in the battery in 10 levels by means of the LCD.
Furthermore, the remaining battery charge warning and overdischarge warning functions are provided.

REMAINING BATTERY CHARGE WARNING FUNCTION

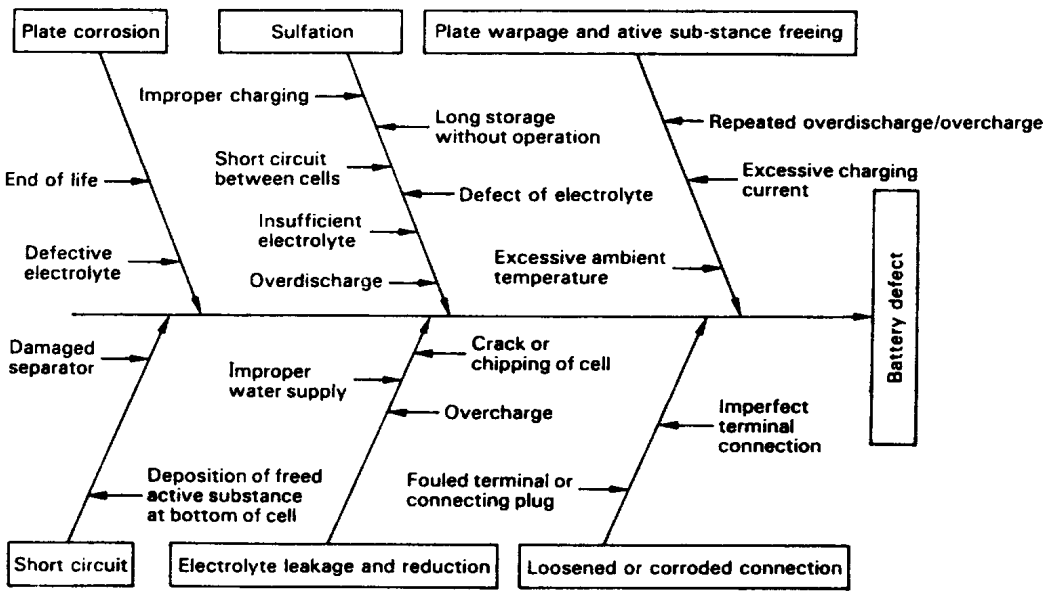
When the remaining battery capacity drops below the set level, the indicator blinks to warn the need of charging.

OVERDISCHARGE WARNING FUNCTION

When the battery capacity decreases further below the set level after the remaining battery charge warning, all indicators blink to warn overdischarge state.
At the same time, the lift interrupt function prohibits material handling operation to protect the battery.

Note:
These set levels can be changed by MCS-II tuning. (See page 5-28.)

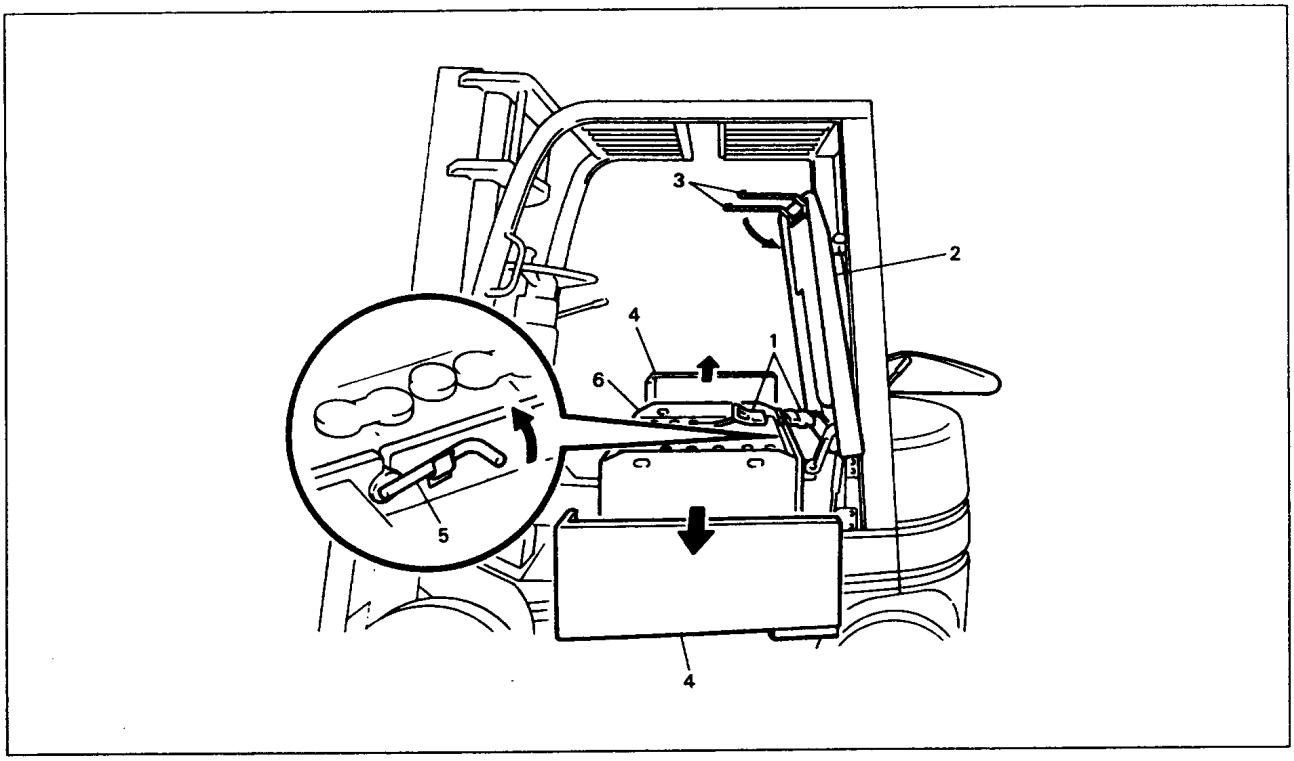
TROUBLESHOOTING



BATTERY ASSY

REMOVAL·INSTALLATION

Battery removal or installation shall always be parformed in no load state (with no load on the fork).



Removal Procedure

1 Disconnect the battery plug.

2 Release the tilt lock and open the battery hood.

3 Fold the hood hook.

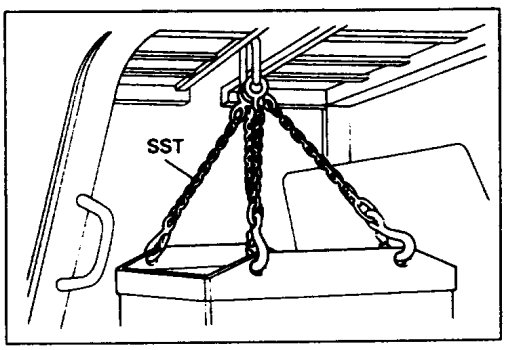
4 Remove the side frame covers.

5 Remove the battery stopper.

6 Remove the battery W/case. **[Point 1]**

Installation Procedure

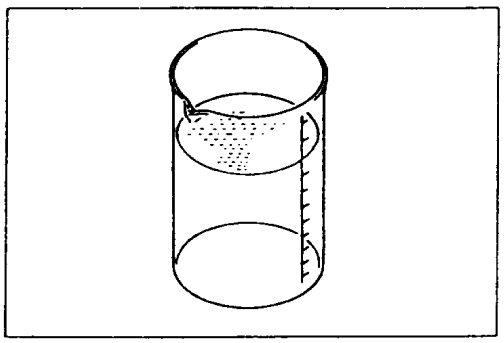
The installation procedure is the reverse of the removal procedure.



Point Operation

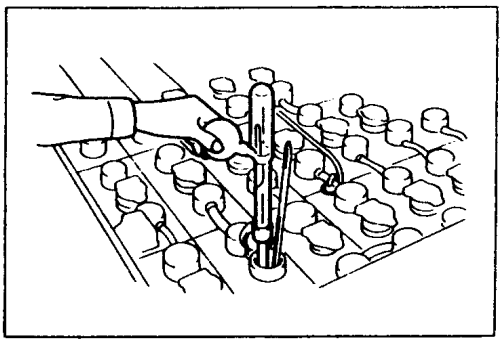
[Point 1]

Removal·Installation: SST 25009-13201-71



INSPECTION

1. Electrolyte inspection
   The battery electrolyte is colorless and transparent in normal state. Inspect any turbidity at the time of specific gravity inspection. If not checked clearly, put the electrolyte in a beaker for inspection.

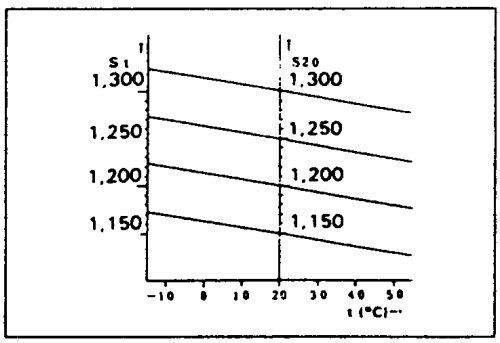


2. Battery electrolyte specific gravity inspection

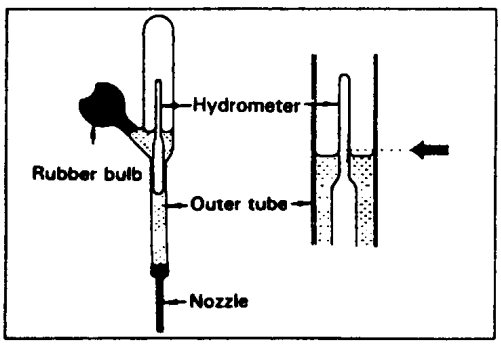
   Use a hydrometer and measure the specific gravity of the electrolyte.

   Specific gravity upon perfect charging:
   1.280 at 20°C (68°F)
   Specific gravity upon end of discharge:
   1.150 at 20°C (68°F)

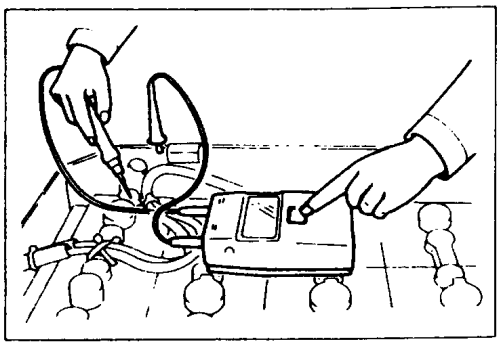
   The specific gravity of the electrolyte is expressed with that at 20°C (68°F) as the standard.



   Equation for converting specific gravity
   S_{20} = St + 0.0007 (t-20)
   S_{20} : Specific gravity at 20°C
   St : Specific gravity at t°C
   t : Electrolyte temperature (°C) at the time of measurement



* How to use the hydrometer
① Insert the nozzle of the hydrometer into the electrolyte port and suck the electrolyte into its outer tube.
② Make the hydrometer in the outer tube float correctly without contact with the outer tube, its top or bottom. Wait until the air bubbles in the sucked electrolyte disappear. Read the scale at the top of the convex surface as shown at left.
③ After the measurement, wash the inside and outside of the hydrometer with clear water, and wipe the hydrometer thoroughly with clean cloth for storage.



3. Insulation resistance inspection
Measure the resistance between the battery and battery case with an insulation resistance meter (megger).

Insulation resistance value: 1 MΩ or more

Note:
- **When the insulation resistance is less than 1 MΩ, remove the battery from the vehicle and wash with water.**
- **After washing with water, make the battery dry thoroughly. Measure the insulation resistance again and install the battery on the vehicle after checking that it is 1 MΩ or more.**

* Battery control table
Prepare the control table for each battery for recording and retaining the inspection results.

Inspection date and time	Inspected cell number	Specific gravity	Electrolyte temperature	Added water quantity	Remarks	Inspector

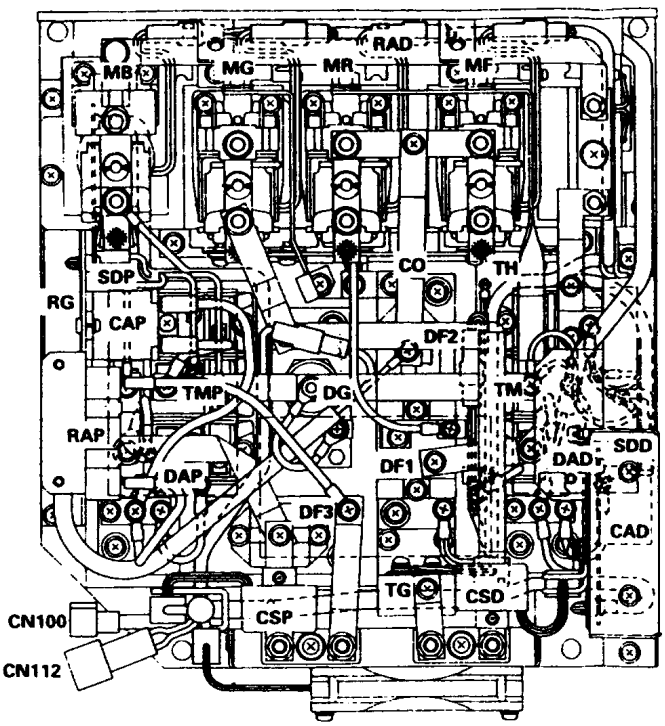
Laddhandskar Toyota FBMF 16-30

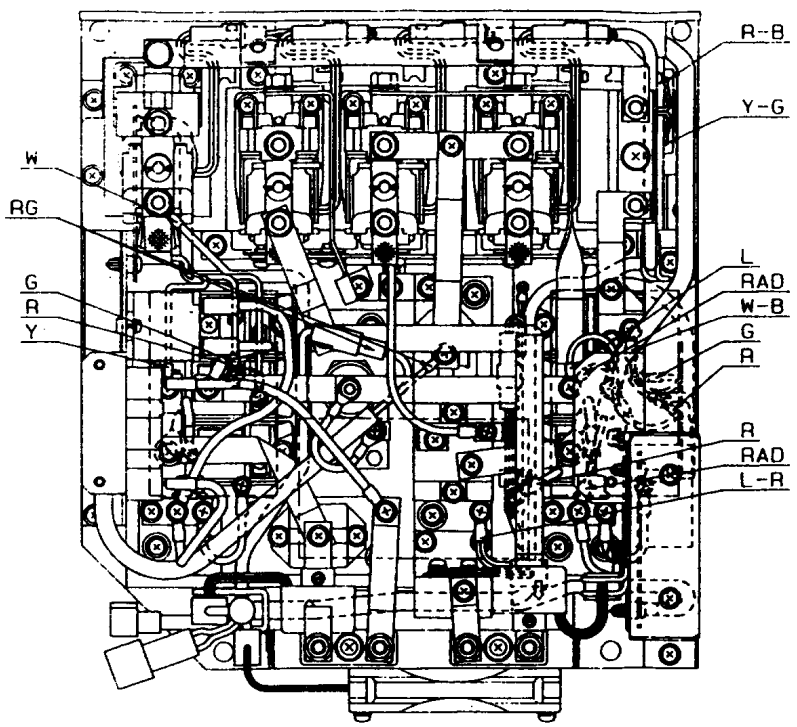
	Hanske FEM 160A	Stift, hjälpkontakt
Batteri, Hona	E00954MAA	E00946MAA
Truck, Hane	E00950MAA	E00947MAA
Laddare, Hane	E00950MAA	

CONTROLLER

MCS-Ⅱ (MICROCOMPUTOR TYPE) CONTROLLER

GENERAL

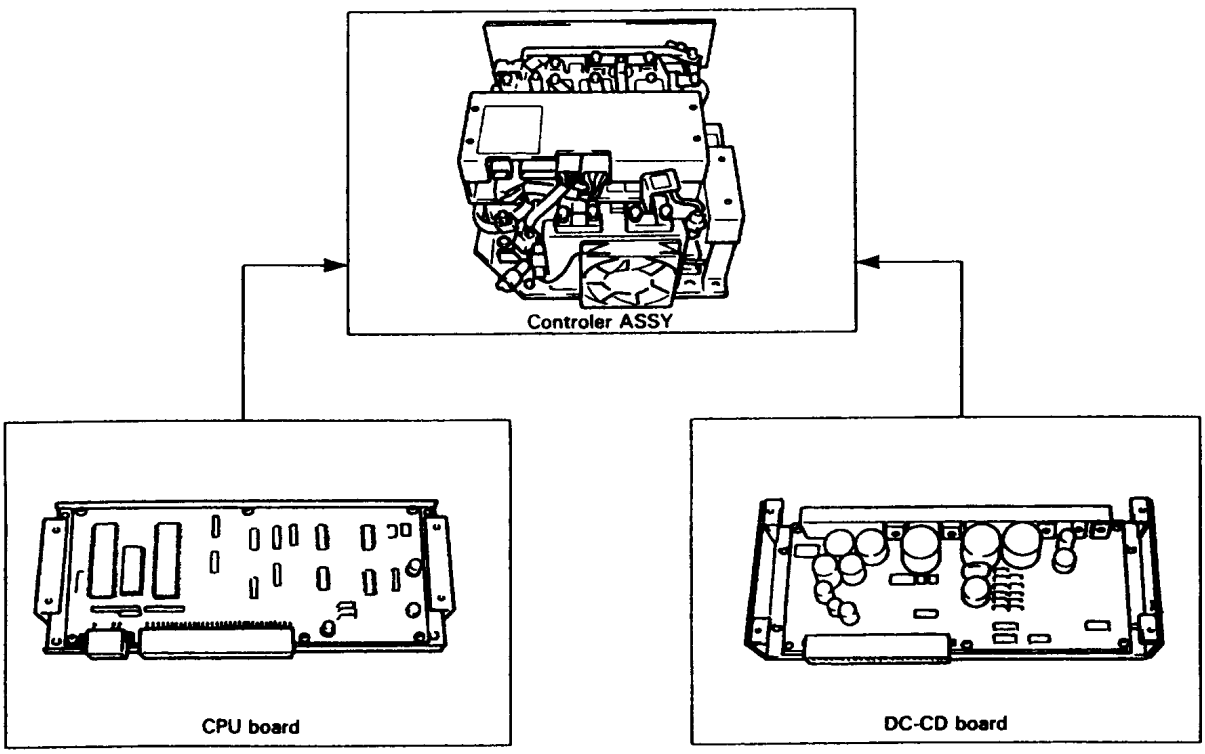




The FBMF series has the diagnosis (self-diagnostic) function to sound the buzzer (beep, beep) and indicate the abnormal part by the corresponding "error code" on the multi-display by automatically detecting any trouble in the main drive and material handling circuits, operating system such as the accelerator, and sensors.

When this display is switched to the analyzer (failure analysis) mode, defective part detection and functional check of the main circuits for traveling and material handling, each operating system and sensors are carried out.

See page 5-2 in multi-display functions section for the diagnosis.
See page 5-8 in multi-display functions section for the analyzer.



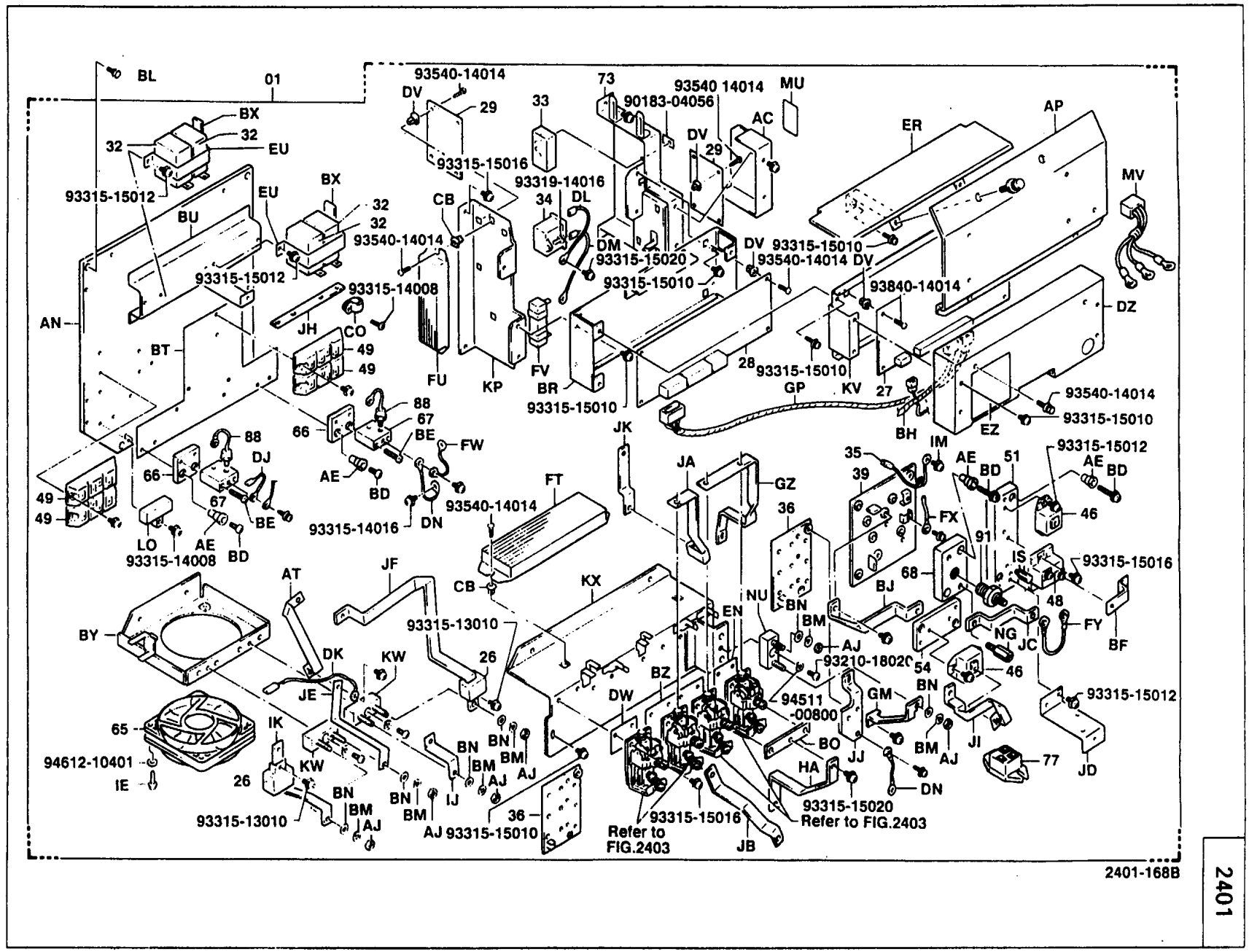
SPECIFICATIONS

		FBMF16	FBMF20·25	FBMF30
Fuses	F1 (Drive fuse)	225A	325A	350A
	F2 (Pump fuse)	200A	〃	225A
	F3 (Power steering fuse)	* 40A	〃	〃
	F4 (Lamp fuse)	10A	〃	〃
	F5 (Control circuit fuse)	10A	〃	〃
	F6 (Power supply)	10A	〃	〃
Transistors	TM (Main transistor)	TSM002 (2 pcs.)	〃	TSM002 (3 pcs.)
	TMP (Main transistor, pump)	TSM002 (2 pcs.)	TSM002 (3 pcs.)	〃
	TG (Regenerative transistor)	ETK81-050	〃	〃
	TMPS (Main transistor, power steering)	#1MI100H-25	〃	〃
Diodes	DAD (Traveling absorber diode)	30MF40	〃	〃
	DAP (Material handling absorber diode)	30MF40	〃	〃
	DG (Regenerative diode)	70M30	〃	〃
	DF1 (DM flywheel)	ESAL73-03C	〃	〃
	DF2 (DM flywheel)	TDM001	〃	〃
	DF3 (PM flywheel)	TDM001	〃	〃
	DF4 (PS flywheel)	#1MI100H-25	〃	〃
Current sensors	CSD (Traveling current sensor)	–	–	–
	CSP (Material handling current sensor)	–	–	–
	CSPS (Power steering current sensor)	MBP20A-10MJN	〃	〃
Capacitors	CAD (Traveling absorber capacitor)	1.5μF	〃	〃
	CAP (Material handling absorber capacitor)	16μF	〃	〃
	CO (Traveling circuit power capacitor)	60μF (4 pcs.)	60μF (5 pcs.)	〃
Contactors	MF (Forward contactor)	MA11M	〃	〃
	MR (Reverse contactor)	MA11M	〃	〃
	MG (Regenerative contactor)	MA22M	〃	〃
	MB (Power supply contactor)	ME251	〃	〃

* F3 (Power steering fuse) Up to 1999.8 : 60A
From 1999.9 : 40A

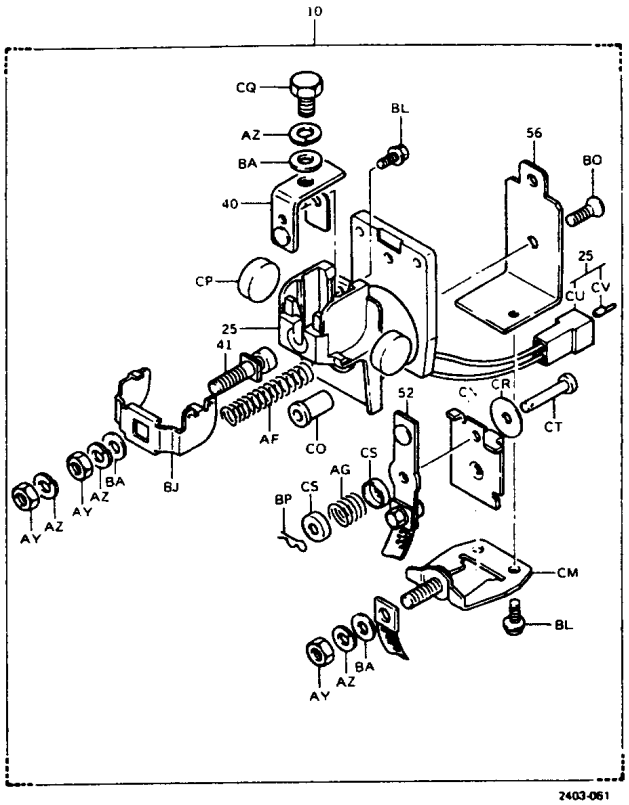
Resistorer

RAD = 1,5 ohm RAP = 25 ohm RG = 1,5 ohm RAG = 30 Kohm RO = >20 Kohm



2401-168B

2403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CQ
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BA
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CP
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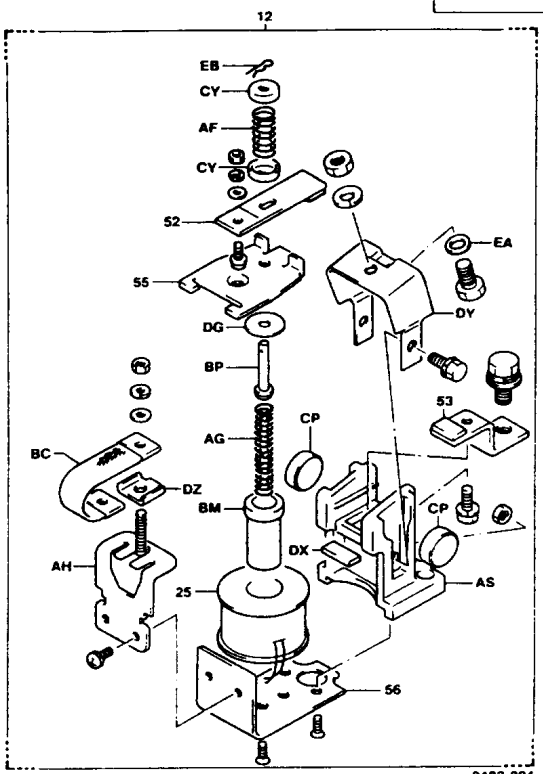
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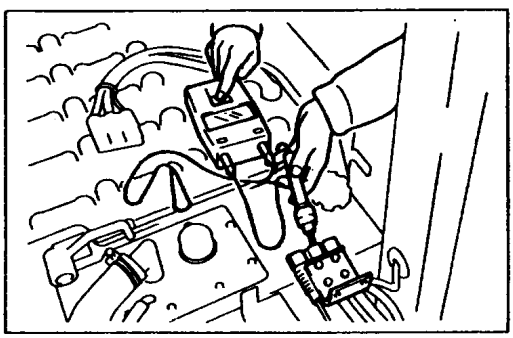
2403-084

ON-VEHICLE INSPECTION

Some components can be inspected without removal from the vehicle while other components require removal before inspection.
The CPU board and DC-CD board are inspected on the vehicle because battery voltage application is necessary.

1. Insulation resistance measurement (always inspect the insulation resistance before starting control panel inspection.)
   (1) Set the battery plug to off and measure the insulation resistance between the battery plug wire harness and body.

Terminals	Battery plug controller and body
Standard	1 MΩ or more (The resistance should be as great as possible, but it varies greatly depending on the vehicle operation status, place and weather.)



2. CPU board and DC-CD board

(1) How to use SST 09240-13200-71

When the cause of a trouble is judged to be in the CPU board or DC-CD board, apply the battery voltage, connect SST 09240-13200-71, and measure the applied voltage and resistance value at each connector.

Note:

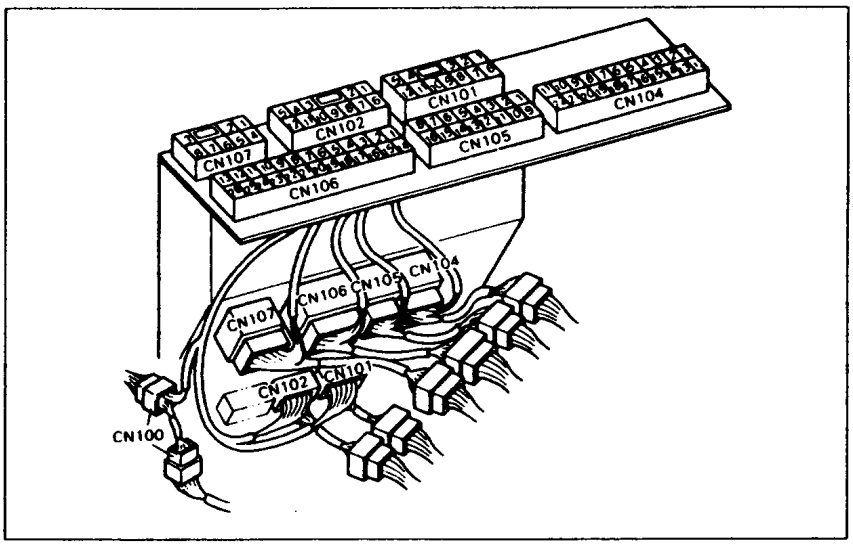
Always disconnect the battery plug before removing or installing the CPU board or DC-CD board.

Caution:

- **Always carry out measurement before replacing the CPU or DC-CD board according to the judgment of a defect of the CPU or DC-CD board by troubleshooting.**
- **Use SST 09240-13200-71 for measurement.**

(2) SST connection method

① Turn off the key switch.
② Disconnect the battery plug.
③ Disconnect the connectors (CN100-CN102 and CN104-CN107) of the CPU and DC-CD board.
④ Connect the SST.



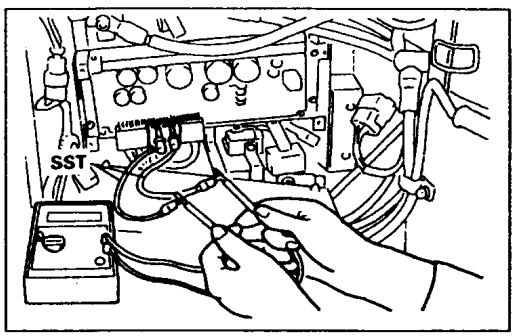
(3) How to use SST 09240-23400-71

Always disconnect the battery plug before setting the SST.

① Disconnect the battery plug.
② Set the SST at the corresponding connector pin.

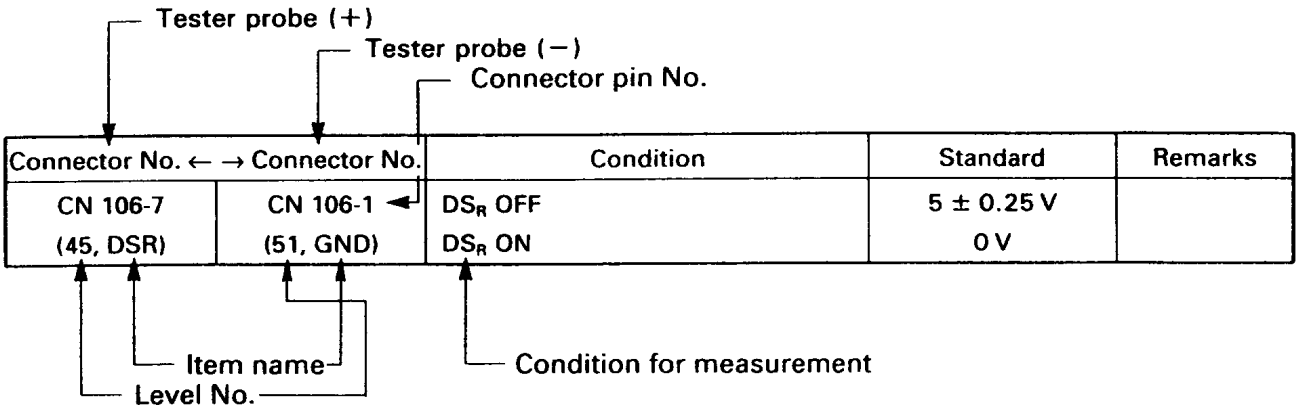
Caution:

If the SST is set without disconnecting the battery plug, the SST (IC clip) may short-circuit between connector pins.



(4) Method for measurement and standard table

① How to read the table



Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 106-7 (45, DSR)	CN 106-1 (51, GND)	DS_R OFF	5 ± 0.25 V	
		DS_R ON	0 V	

② Table

CN101 Connector: Basic conditions (battery plug ON and key switch OFF)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 101-1	CN 101-5	Unused		
CN 101-2 (4, MG)	CN 101-5 (1, M+)	Battery plug OFF Measure the resistance with the ⊖ probe (of circuit tester) in contact with CN101-5.	Approx. 35 Ω	MG contactor
CN 101-2 (4, MG)	CN 101-7 (N2, GND)	Measure the voltage applied to the MG coil with the ⊕ probe (of circuit tester) in contact with CN101-2. Key switch ON	Approx. 70 V (For 72 V battery) Approx. 78 V (For 80 V battery)	MG coil
CN 101-3 (2, MF)	CN 101-5 (1, M+)	Battery plug OFF Measure the resistance with the ⊖ probe (of circuit tester) in contact with CN101-5.	Approx. 35 Ω	MF contactor
CN 101-3 (2, MF)	CN 101-7 (N2, GND)	Measure the voltage applied to the MF coil with the ⊕ probe (of circuit tester) in contact with CN101-3. Key switch ON	Approx. 70 V (For 72 V battery) Approx. 78 V (For 80 V battery)	MF coil
CN 101-4 (P2, TGC)	CN 101-7 (N2, GND)	Key switch ON	72 V (For 72 V battery) 80 V (For 80 V battery)	TG collector
CN 101-5 (1, M+)	CN 101-7 (N2, GND)	Key switch ON	Approx. 70 V (For 72 V battery) Approx. 78 V (For 80 V battery)	Contactor power supply
CN 101-6 (P1A, MB80V)	CN 101-7 (N2, GND)	Key switch ON	72 V (For 72 V battery) 80 V (For 80 V battery)	Voltage after MB

CN101 Connector: Basic conditions (battery plug ON and key switch OFF)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 101-8 (3, MR)	CN 101-5 (1, M+)	Battery plug OFF Measure the resistance with the ⊖ probe (of circuit tester) in contact with CN101-5.	Approx. 35 Ω	MR contactor
CN 101-8 (3, MR)	CN 101-7 (N2, GND)	Measure the voltage applied to the MR coil with the ⊕ probe (of circuit tester) in contact with CN101-8. Key switch ON	Approx. 70 V (For 72 V battery) Approx. 78 V (For 80 V battery)	MR coil
CN 101-9 (43, K48V)	CN 101-7 (N2, GND)	Key switch ON	48 V	Voltage at after the key switch
CN 101-10 (P10, TGE)	CN 101-7 (N2, GND)	Key switch ON	Approx. 0 V	TG emitter
CN 101-11 (91, TGB)	CN 101-7 (N2, GND)	Key switch ON	Approx. 1 V	TG base
CN 101-12 (41, B48V)	CN 101-7 (N2, GND)		48 V	Voltage at battery

CN102 Connector: Basic conditions (battery plug ON and key switch OFF)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 102-1		Unused		
CN102-2 (6, MB)	CN 101-5 (1, M+)	Battery plug OFF Measure the resistance with the ⊖ probe (of circuit tester) in contact with CN101-5.	Approx. 20 Ω	MB contactor
CN 102-2 (6, MB)	CN 101-7 (N2, GND)	Measure the voltage applied to the MB coil with the ⊕ probe (of circuit tester) in contact with CN102-2. Key switch ON.	70 V (For 72 V battery) 78 V (For 80 V battery)	MB coil
CN 102-3 (12, -5V)	CN 102-10 (11, GND)	Key switch ON	-5 ~ -6 V	-5 V
CN 102-4 (12, -5V)	CN 102-10 (11, GND)	Key switch ON	-5 ~ -6 V	-5 V
CN 102-5		Unused		
CN 102-6 (18, F80V)	CN 102-10 (11, GND)		72 V (For 72 V battery) 80 V (For 80 V battery)	Battery voltage
CN 102-7		Unused		
CN 102-8 (10, +5V)	CN 102-10 (11, GND)	Key switch ON	5.1 ~ 5.3 V	+5 V
CN 102-9 (10, +5V)	CN 102-10 (11, GND)	Key switch ON	5.1 ~ 5.3 V	+5 V
CN 102-12		Unused		

CN104 Connector: Basic conditions (battery plug ON and key switch ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 104-1 (15, +30 V)	CN 104-22 (N2, GND)		25.5 ~ 30.5 V	
CN104-2		Unused		
CN104-3 (21, PRE)	CN 104-22 (N2, GND)		5 ± 0.25 V	
CN 104-4 (22, VCON)	CN 104-22 (N2, GND)	Key switch OFF	0 V	
CN 104-5 (27, CHOPC)	CN 104-22 (N2, GND)		1 ~ 5 V	
CN 104-6 (23, MDMB)	CN 104-22 (N2,GND)	MB OFF (Key Switch OFF)	0 V	
		MB ON	5 ± 0.25 V	
CN 104-7 (24, MDMG)	CN 104-22 (N2, GND)	MG OFF	0 V	
		MG ON	5 ± 0.25 V	
CN 104-8 (25, MDMR)	CN 104-22 (N2, GND)	MR OFF	0 V	
		MR ON	5 ± 0.25 V	
CN 104-9 (26, MDMF)	CN 104-22 (N2, GND)	MF OFF	0 V	
		MF ON	5 ± 0.25 V	
CN 104-10 (N2, GND)	CN 104-22 (N2, GND)	Key switch OFF	0 V	
CN 104-11		Unused		
CN 104-12 (28, +5 V)	CN 104-22 (N2, GND)		5 ± 0.25 V	
CN 104-13		Unused		
CN 104-14		Unused		
CN104-15 (29, OPTO1)	CN 104-22 (N2, GND)	Key switch OFF	0 V	
		Key switch ON	+5 V	
CN 104-16 CN 104-17		Unused		
CN 104-18 (13, VBBT)	CN 104-22 (N2, GND)		Approx. 48 V	
CN 104-19 (14, VBKY)	CN 104-22 (N2, GND)	Key switch ON	Approx. 48 V	
		Key switch OFF	0 V	
CN 104-20 (20, VBP2)	CN 104-22 (N2, GND)		Approx. 72 V	(For 72 V battery)
			Approx. 80 V	(For 80 V battery)
CN 104-21 (N2, GND)	Panel N1 terminals		Continuity shall exist.	

CN105 Connector: Basic conditions (battery plug ON and key switch ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 105-1 (75, THC)	CN 105-4 (74, GND)		More than 0 V and less than 5 V	
CN 105-2 (36, VDP-)		Not measurable		
CN 105-3 (31, VDD-)		Not measurable		
CN 105-4 (74, GND)	Panel N1 terminal		Continuity shall exist.	
CN 105-5 (73, +5V)	CN 105-4 (74, GND)		5 ±0.25 V	
CN 105-6 (73, +5V)	CN 105-4 (74, GND)		5 ±0.25 V	
CN 105-7 (37, +5V)	CN 105-4 (74, GND)		5 ±0.25 V	
CN 105-8 (32, +5V)	CN 105-4 (74, GND)		5 ±0.25 V	
CN 105-9 (76, +5V)	CN 105-4 (74, GND)		5 ±0.25 V	
CN 105-10 (35, VDP+)		Not measurable		
CN 105-11 (30, VDD+)		Not measurable		
CN 105-12 (74, GND)	CN 105-4 (74, GND)		0 V	
CN 105-13 (72, CSP)	CN 105-4 (74, GND)	Material handling in stopped state	0 ~ 0.1 V	
CN 105-14 (71, CSD)	CN 105-4 (74, GND)	Traveling in stopped state	0 ~ 0.1 V	
CN 105-15 (38, CHOPP)	CN 105-4 (74, GND)		4 V ~ 5 V	
CN 105-16 (33, CHOPD)	CN 105-4 (74, GND)		4 V ~ 5 V	

CN106 Connector: Basic conditions (battery plug ON and key switch ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 106-1 (51, GND)	Panel N1 terminal		Continuity shall exist.	
CN 106-2 (84, SS2-)	CN 106-3 (83, SS2+)	Traveling in stopped state	0 V	
CN 106-3 (83, SS2+)	CN 106-2 (84, SS2-)	Traveling in stopped state	0 V	
CN 106-4 (82, SS1-)	CN 106-5 (81, SS1+)	Traveling in stopped state	0 V	
CN 106-5 (81, SS1+)	CN 106-4 (82, SS1-)	Traveling in stopped state	0 V	
CN 106-6 (46, DSF)	CN 106-1 (51, GND)	DS_F OFF DS_F ON	5 ± 0.25 V 0 V	Diagnosis non-operating voltage 2 V or more 0.8 V or less
CN 106-7 (45, DSR)	CN 106-1 (51, GND)	DS_R OFF DS_R ON	5 ± 0.25 V 0 V	Diagnosis non-operating voltage 2 V or more 0.8 V or less
CN 106-8 (64, SWAC)	CN 106-1 (51, GND)	SW_{AC} OFF SW_{AC} ON	5 ± 0.25 V 0 V	Diagnosis non-operating voltage 2 V or more 0.8 V or less
CN 106-9 (65, SWB)	CN 106-1 (51, GND)	SW_B OFF SW_B ON	0 V 5 ± 0.25 V	Diagnosis non-operating voltage 2 V or more 0.8 V or less
CN 106-10 (77, SWSC)	CN 106-1 (51, GND)	SW_{SC} OFF SW_{SC} ON	5 ± 0.25 V 0 V	Diagnosis non-operating voltage 2 V or more 0.8 V or less
CN 106-11		Unused		
CN 106-12		Unused		
CN 106-13 (51, GND)	CN 106-1 (51, GND)		0 V	
CN 106-14 (51, GND)	CN 106-1 (51, GND)		0 V	
CN 106-15 (53, POT+)	CN 106-1 (51, GND)		3 ~ 4 V	

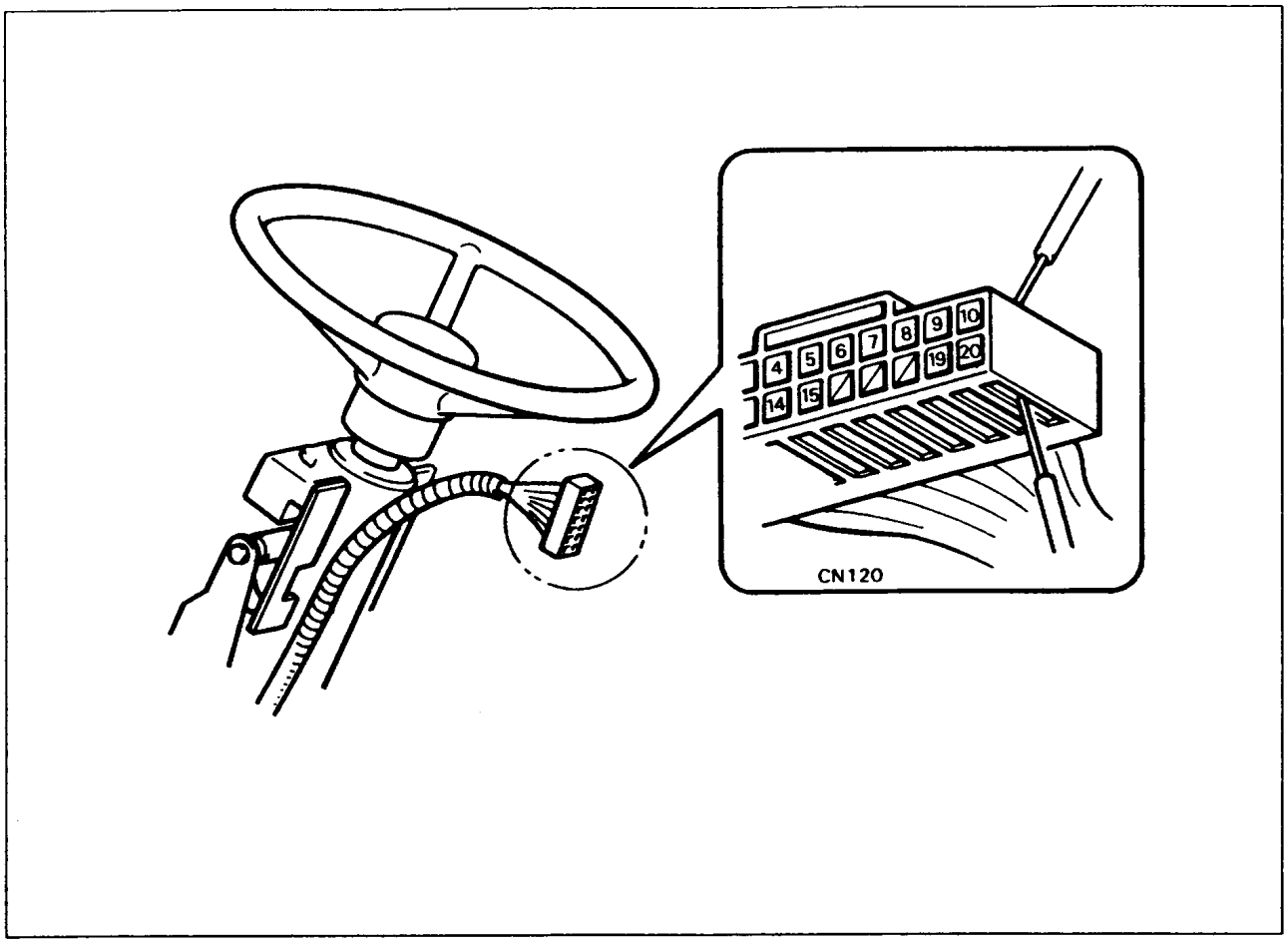
CN106 Connector: Basic conditions (battery plug ON and key switch ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 106-16 (52, POTA)	CN 106-1 (51, GND)	(Shall vary smoothly according to the traveling accelerator operation.)	More than 0 V and 4 V or less	See page 5-8 for the analyzer.
CN 106-17		Unused		
CN 106-18 (55, POTL)	CN 106-1 (51, GND)	Shall vary smoothly according to the material handling accelerator operation.	More than 0 V and 4 V or less	See page 5-8 for the analyzer.
CN 106-19 (60, LSL)	CN 106-1 (51, GND)	LS_L OFF	5 ± 0.25 V	
		LS_L ON	0 V	
CN 106-20 (61, LST)	CN 106-1 (51, GND)	LS_T OFF	5 ± 0.25 V	
		LS_T ON	0 V	
CN 106-21		Unused		
CN 106-22 (63, LSAT2)	CN 106-1 (51, GND)	LS_{ATT} OFF	5 ± 0.25 V	
		LS_{ATT} ON	0 V	
CN 106-23 (66, LSPB)	CN 106-1 (51, GND)	LS_{PB} OFF	5 ± 0.25 V	
		LS_{PB} ON	0 V	
CN 106-24 (LSAT3)	CN 106-1 (51, GND)		5± 0.25 V	
CN 106-25 (67, LSD)	CN 106-1 (51, GND)	LS_D OFF	5 ± 0.25 V	
		LS_D ON	0 V	
CN 106-26		Unused		

CN107 Connector: Basic conditions (battery plug ON and key switch ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 107-1 (141, SMTDA)	CN 107-6 (17, GND)		0 ~ 1 V	
CN 107-2 (142, SDTMA)		Not measurable		
CN 107-3		Unused		
CN 107-4 (144, SMTDK)	CN 107-6 (17, GND)		0 V	
CN 107-5 (143, SDTMK)		Not measurable		
CN 107-6 (17, GND)	Panel N1 terminal		Continuity shall exist.	
CN 107-7		Unused		
CN 107-8 (16, +30 V)	CN 107-6 (17, GND)		25.5 ~ 30.5 V	

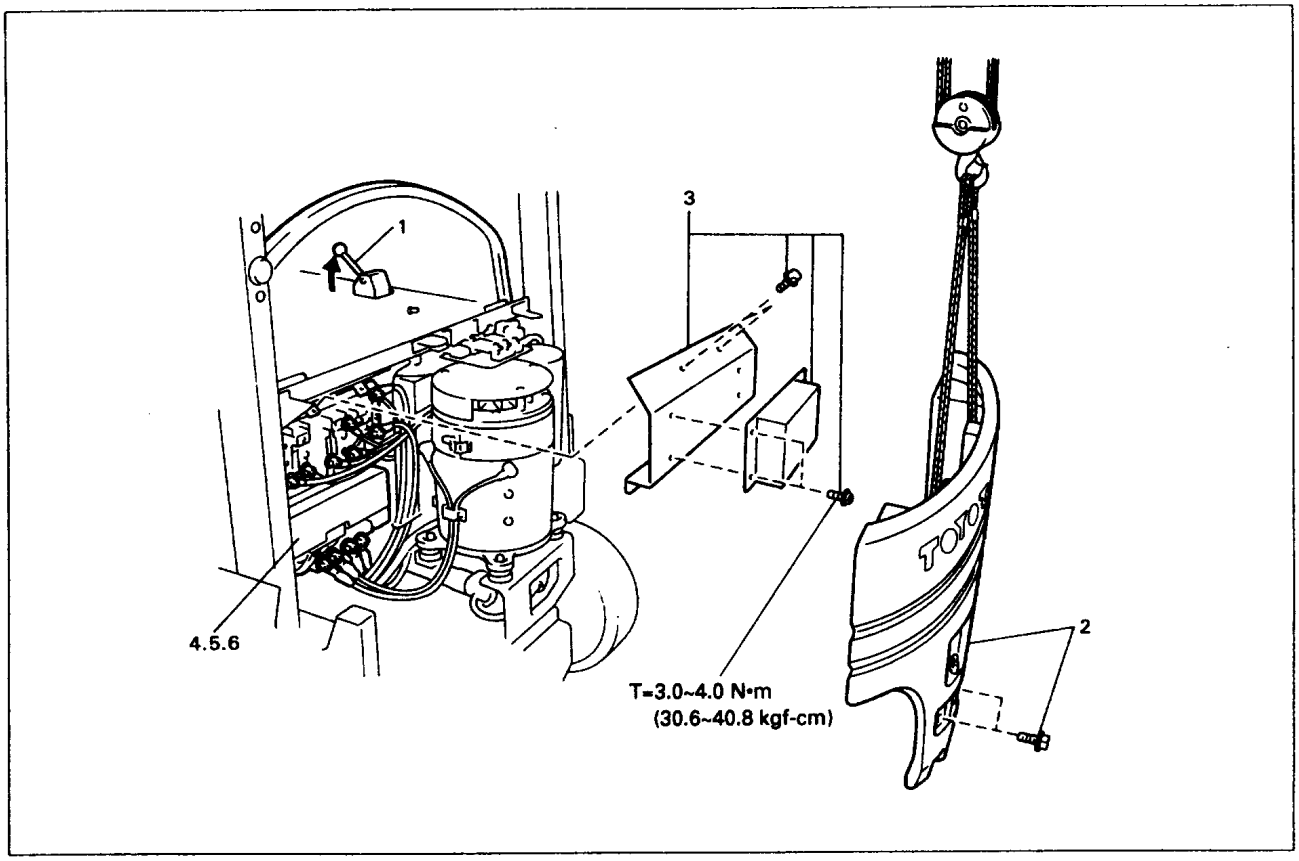
3. Display
When the cause of a trouble is judged to exist in the display, apply the battery voltage and measure the voltages applied to each connector.



CN120 Connector: Basic condition (battery plug ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 120-9 (16, +30V)	CN 120-19 (17, GND)		25.5 ~ 30.5 V	
CN 120-10 (104, BL)	CN 120-20 (N1, GND)	Light switch ON	Approx. 48 V	

REMOVAL·INSTALLATION



Removal Procedure

1 Disconnect the battery plug.

2 Remove the counter weight. (See page 13-6)

3 Remove the EPS controller and controller cover.

4 Disconnect the connectors of the CPU board and DC-CD board.

5 Disconnect the controller wirings.

6 Remove the controller ASSY.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

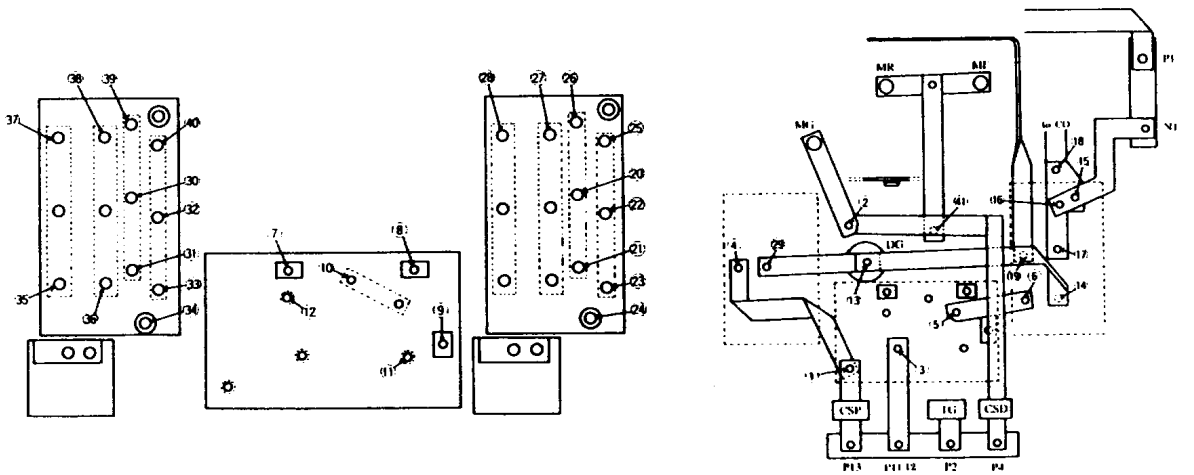
Note:
- **Before reconnecting the battery plug, check cable connection to eliminate any omission or insufficient tightening. If loose, elements in the control panel may be damaged.**
- **Check the wiring in the installation work for correct connection. (See page 4-25)**

DISASSEMBLY·INSPECTION·REASSEMBLY

Disassembly Procedure

Note:

- **The D board, T_D board and T_P board are removed sequentially in this operation.**
- **In this operation, removal of the SDD and SDP board is omitted. Remove either of them as required by referring to the assembly drawing and internal wiring diagram (see page 4-2). To remove the T_D board and T_P board, removal of the SDD board and SDP board are required, respectively.**
- **Keep the removed screws orderly to prevent incorrect use.**



Screw No.	Level No.	Harness color (Destination of connection)	Destination of copper bar connection	Removal board
①	P14		T_P board	D board
②	P4		MG	
③	P11	B (RAP)	P11	
④	P14	Y (Harness)	D board	
⑤	P8		T_D board	
⑥	P8	B (DAD)	D board	
⑦	N1	Y (DG)		
⑧	P2	B (CO)		
⑨	P31	R (Harness)		
⑩	P8			
⑪	P2	L-R (Harness)		
⑫	P3			
⑬	N1	Y (D board)	T_D·T_P board	T_D board
⑭	N1		DG	
⑮	N1	W-B (Harness)	N1 terminal	
⑯	N1		N1 terminal	
⑰	N1	G (CAD)	N1 terminal CO	
⑱	N1		T_D board	
⑲	P8	L (Harness) W (RAD)		
⑳	N1	G (Harness)		

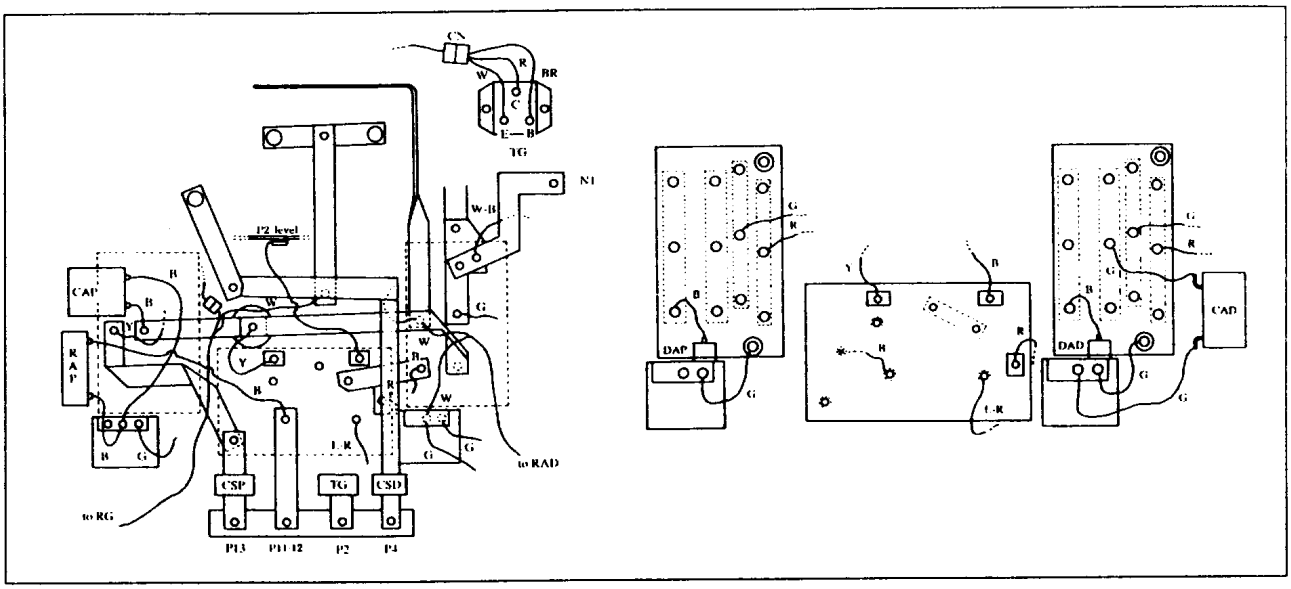
Screw No.	Level No.	Harness color (Destination of connection)	Destination of copper bar connection	Removal board
㉑	N1			T_D board
㉒	92	R (Harness)		
㉓	92			
㉔	P9	G (DAD)		
㉕	92			
㉖	N1			
㉗	N1			
㉘	P8			
㉙	N1	B (CAP)	DG	T_P board
㉚	N1	G (Harness)		
㉛	N1			
㉜	93	R (Harness)		
㉝	93			
㉞	P15	G (DAD)		
㉟	P14	B (DAP)		
㊱	N1			
㊲	P14			
㊳	N1			
㊴	N1			
㊵	93			
㊶	P5	W (RG)	MF·MR	

Reassembly Procedure

Reassembly procedure is the reverce of disassembly procedure.

Note:

- **Connect the wiring correctly by referring to the diagram below. Incorrect wiring may cause another trouble.**
- **Tighten the bar and harness mounting nuts and screws to the specified torques, and always coat Locktite (thread tightener). Loosening or insufficient tightening (tightening failure) will cause new troubles.**
- **Always coat silicone grease for parts applied with silicone grease. Omission of coating may cause overheating.**
- **After completion of installation, check no contact of the bar and wiring at unnecessary places. Use a circuit tester to check continuity at check points before installation on the vehicle. (See page 4-25 for the check points with the circuit tester.)**



- **Tightening torque for each portion is as follows:**

Item			Tightening torque N·m (kgf-cm) [ft-lbf]
TM, TMP	For harness setting	M5	1.47 ~ 1.96 (15 ~ 20) [1.09 ~ 1.45]
		M4	0.98 ~ 1.47 (10 ~ 15) [0.72 ~ 1.09]
	For mounting	M5	2.45 ~ 2.94 (25 ~ 30) [1.81 ~ 2.17]
DF1	For harness setting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]
	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]
DF2, 3	For harness setting	M5	1.47 ~ 1.96 (15 ~ 20) [1.09 ~ 1.45]
	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]
DG	For main terminal	M6	2.16 ~ 2.75 (22 ~ 28) [1.59 ~ 2.03]
	For mounting	M20	21.28 ~ 21.87 (217 ~ 223) [15.70 ~ 16.13]
DAD, DAP	For mounting	M6	2.45 ~ 3.43 (25 ~ 35) [1.81 ~ 2.53]
TG	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]
Heat sink	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]
Terminal bolt for external connection		M8	9.31 ~ 10.3 (95 ~ 105) [6.87 ~ 7.60]

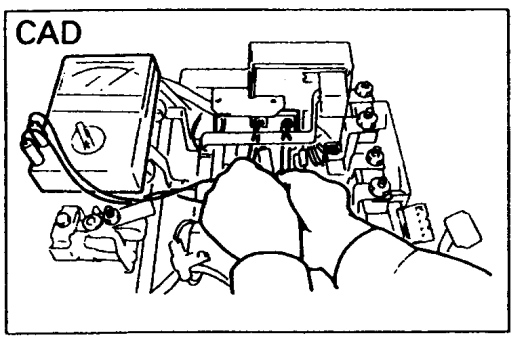
Inspection

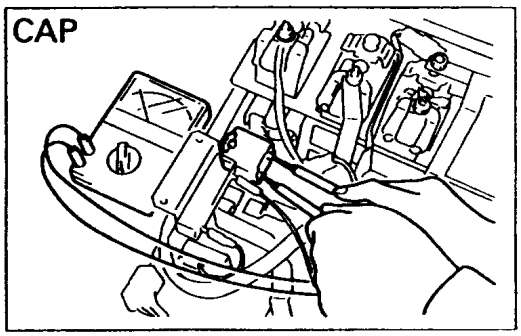
1. Insulation resistance mesurement (See page 4-7)
2. CAD (Traveling circuit absorber capacitor) and CAP (material handling circuit absorber capacitor)
   (1) Inspection method
   Disconnect the CAD and CAP wirings after discharging CAD and CAP through a resistance of about 100 Ω.

Inspection point	Terminals	Circuit tester range
CAD	Both terminals of CAD (DAD side and TM side)	Ω x 1K
CAP	Both terminals of CAP (DAP side and TMP side)	

Standard

The circuit tester pointer deflects when circuit tester probes are brought into contact with the terminals of CAD or CAP, gradually returns toward ∞ then, and finally indicates ∞. (∞ Ω results because the capacitor is charged by the circuit tester current.)



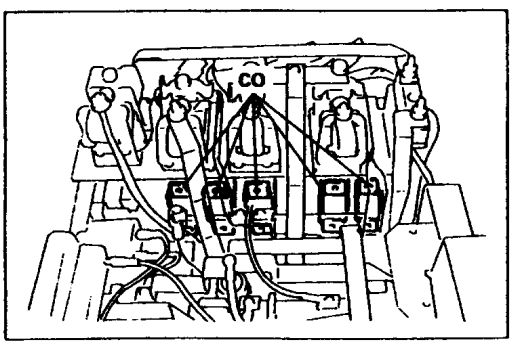


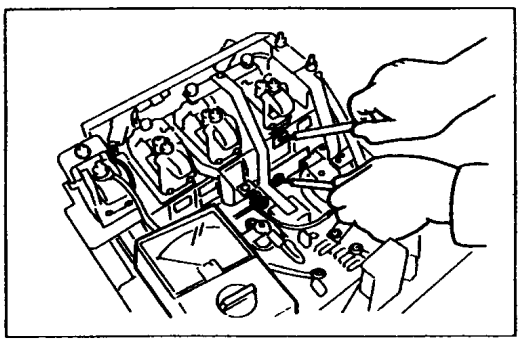
3. CO (Traveling circuit power capacitor)
   (1) Inspection method
   Disconnect the CO capacitor wiring (copper bar), and disconnect the CO wiring after discharging CO through a resistance of about 100 Ω.

Inspection point	Terminals	Circuit tester range
CO	Both terminals of CO	Ω x 1 K

Standard

The circuit tester pointer deflects once to 0 Ω side when circuit tester probes are brought into contact with the terminals of CO. Gradually returns toward ∞ Ω then, and finally indicates ∞ Ω. ∞ Ω results because the capacitor is charged by the circuit tester current.

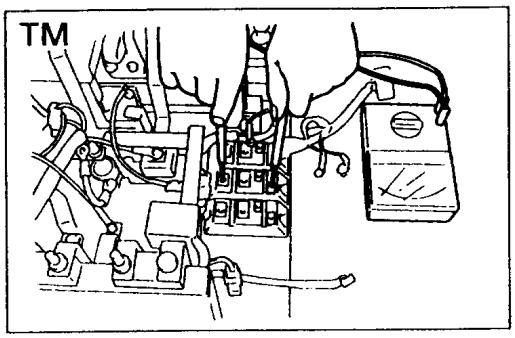


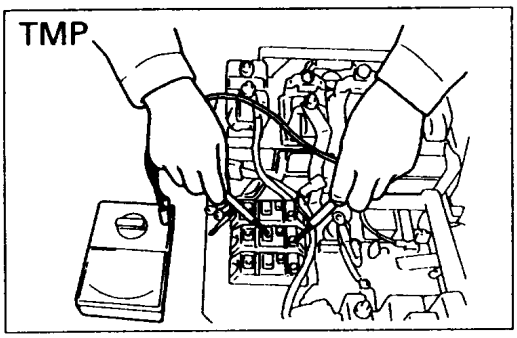


4. TM (main transistor) and TMP (main transistor, pump)
   (1) Inspection method
   Disconnect the TM and TMP wirings.

Inspection point	Terminals		Standard	Circuit tester range
TM TMP	Between D and S	D (−) probe ——— S (+) probe	∞ Ω	Ω x 1K
		D (+) probe ——— S (−) probe	∞ Ω	
	Between D and G	D (−) probe ——— G (+) probe	∞ Ω	
		D (+) probe ——— G (−) probe	Continuity shall exist.	
	Between G and S	G (−) probe ——— S (+) probe	Continuity shall exist.	
		G (+) probe ——— S (−) probe	∞ Ω	

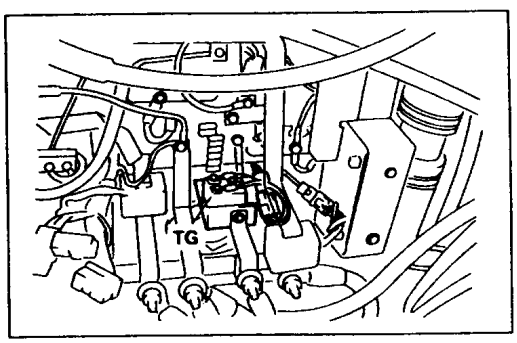
If any abnormality is found in inspection for each of TM and TMP, replace them as a set.

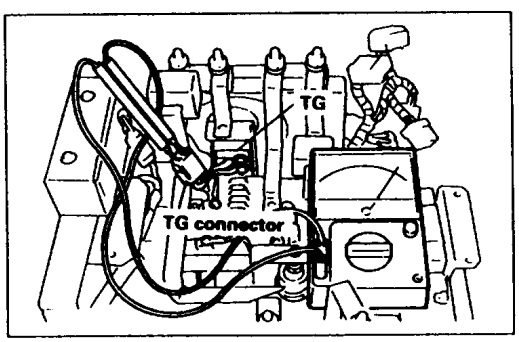




5. TG (regenerative transistor)
   (1) Inspection method
   Disconnect the TG wiring.

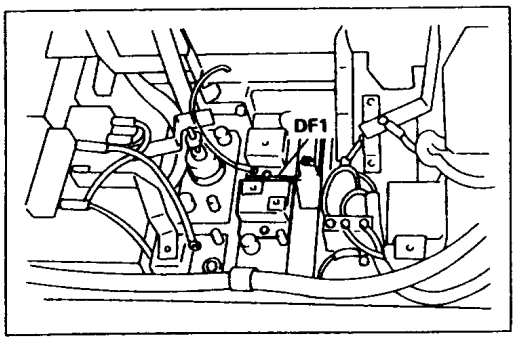
Inspection point	Terminals		Standard	Circuit tester range
TG	Between B and C	B (−) probe ——— C (+) probe	Continuity shall exist.	Ω x 1K
		B (+) probe ——— C (−) probe	∞ Ω	
	Between C and E	C (−) probe ——— E (+) probe	∞ Ω	
		C (+) probe ——— E (−) probe	Continuity shall exist.	

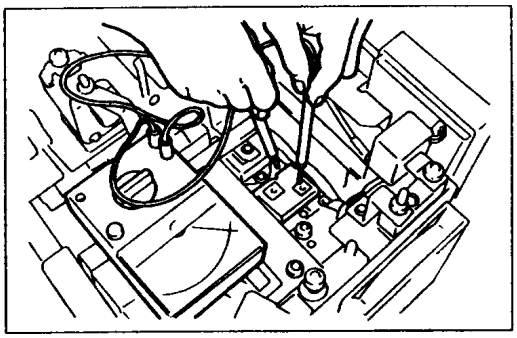




6. DF1 (flywheel diode No.1)
   (1) Inspection method
   Disconnect the DF1 wiring.

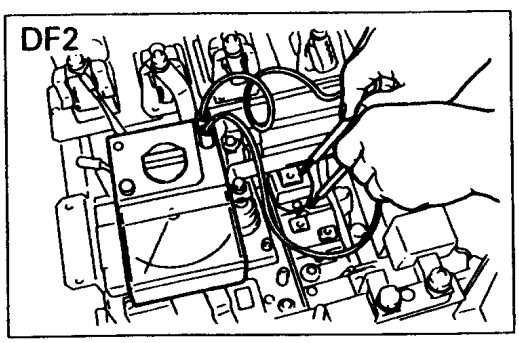
Inspection point	Terminals	Standard	Circuit tester range
DF1	Forward direction: Anode: ⊖ probe ——— cathode: ⊕ probe	Approx. 3 kΩ	Ω x 1K
	Reverse direction: Anode: ⊕ probe ——— cathode: ⊖ probe	∞ Ω	

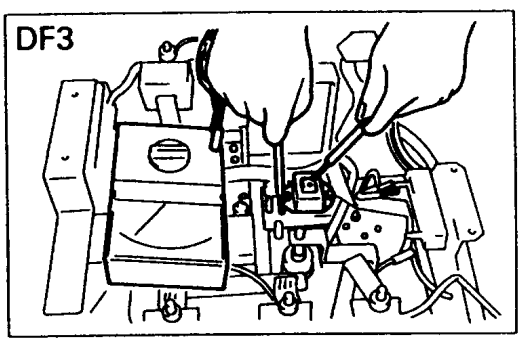




7. DF2 and DF3 (flywheel diodes No.2 and No.3)
   (1) Inspection method
   Disconnect the DF2 and DF3 wirings.

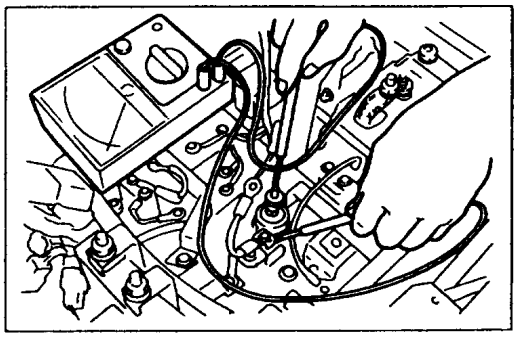
Inspection point	Terminals	Standard	Circuit tester range
DF2 DF3	Forward direction: Anode:⊖ probe ——— cathode:⊕ probe	Approx. 6 kΩ	Ω x 1K
	Reverse direction: Anode:⊕ probe ——— cathode:⊖ probe	∞ Ω	





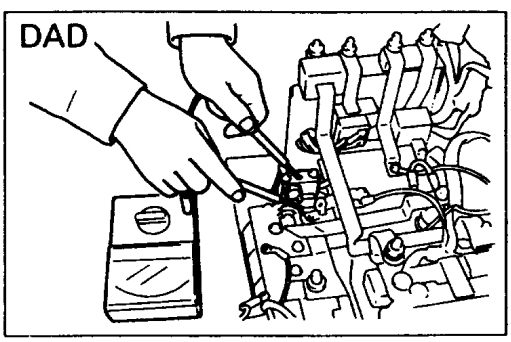
8. DG (regeneration diode)
   (1) Inspection method
   Disconnect the DG wiring.

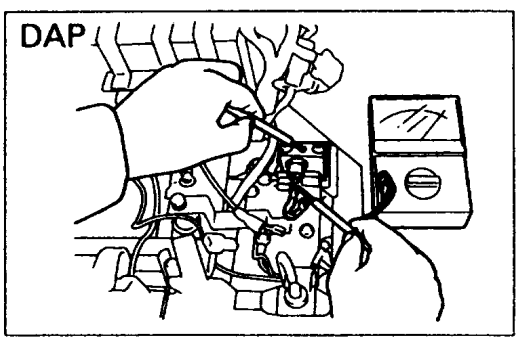
Inspection point	Terminals	Standard	Circuit tester range
DG	Forward direction: Anode: ⊖ probe ——— cathode: ⊕ probe	Approx. 3 kΩ	Ω x 1K
	Reverse direction: Anode: ⊕ probe ——— cathode: ⊖ probe	∞ Ω	



9. DAD (Traveling absorber diode) and DAP (Material handling absorber diode)
   (1) Inspection method
   Disconnect the DAD and DAP wirings.

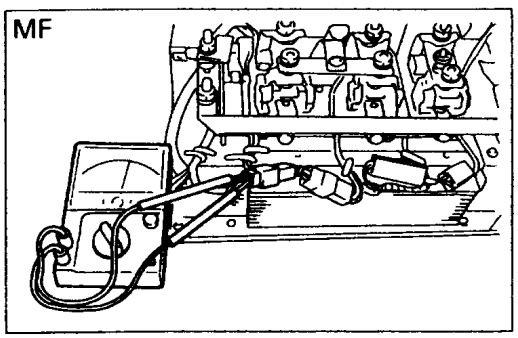
Inspection point	Terminals	Standard	Circuit tester range
DAD DAP	Forward: Anode: ⊖ probe ——— cathode: ⊕ probe	Approx. 6 kΩ	Ω x 1K
	Reverse: Anode: ⊕ probe ——— cathode: ⊖ probe	∞ Ω	

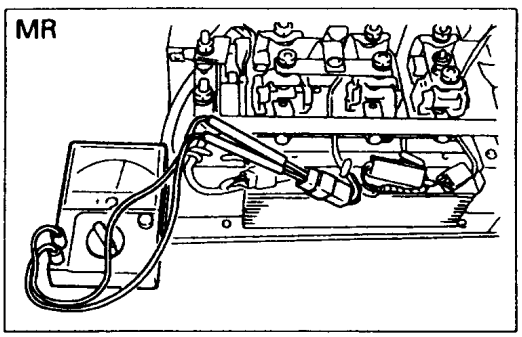


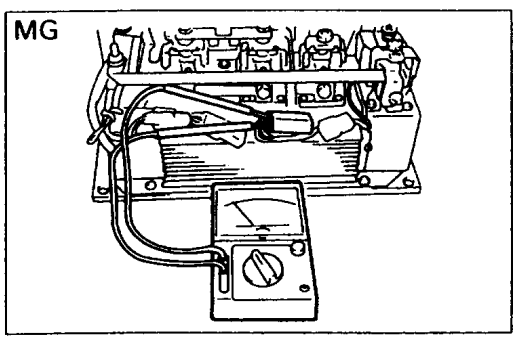


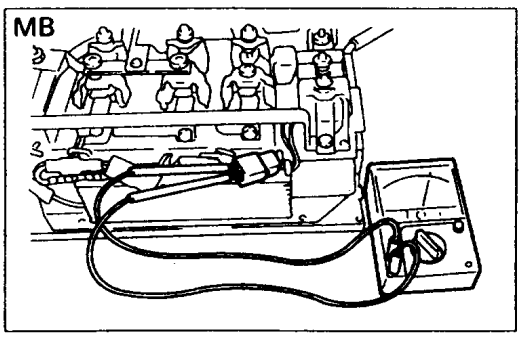
10. MF (forward contactor), MR (reverse contactor), MG (regenerative contactor) and MB (Power supply contactor)
    (1) Inspection method
    Measure the insulation resistance values of MF, MR, MG and MB coils.

Inspection point	Terminals	Standard	Circuit tester range
MF coil	MF coil connector	35 Ω (20°C(68°F))	Ω x 1
MR coil	MR coil connector		
MG coil	MG coil connector		
MB coil	MB coil connector	20 Ω(20°C(68°F))	



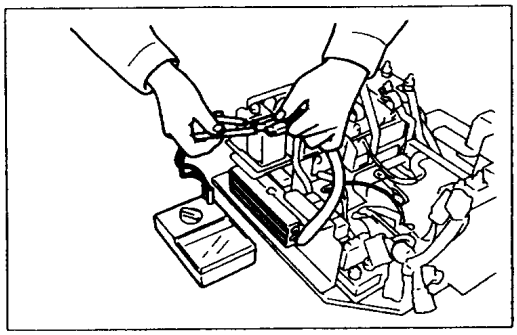






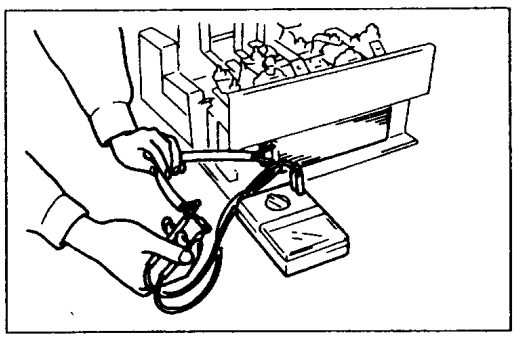
11. RG (regenerative resistor)
(1) Inspection method
Disconnect one side of the RG wiring.

Inspection point	Terminals	Standard	Circuit tester range
RG	Both terminals of RG	Approx. 1.5 Ω	Ω x 1



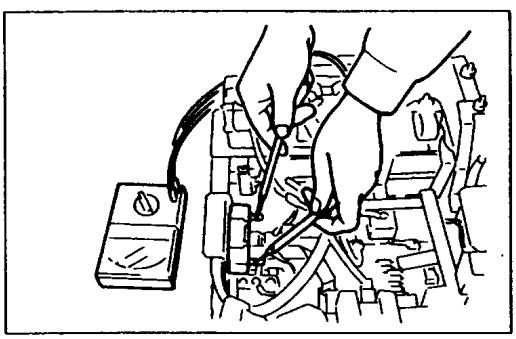
12. RAD (Traveling absorber resistor)
(1) Inspection method
Disconnect one side of the RAD wiring.

Inspection point	Terminals	Standard	Circuit tester range
RAD	Both terminals of RAD	Approx. 1.5 Ω	Ω x 1

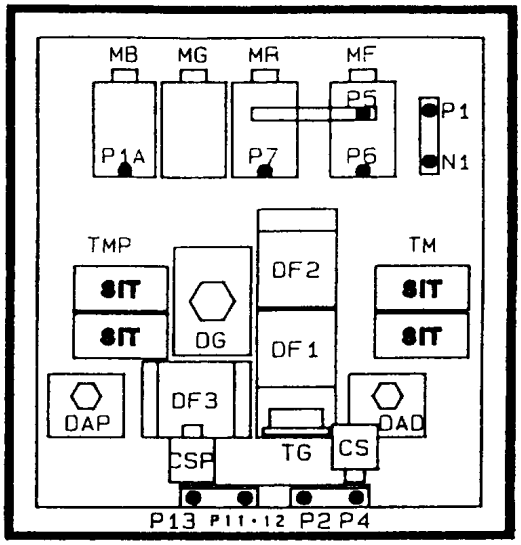


13. RAP (Material handling absorber resistor)
(1) Inspection method
Disconnect one side of the RAP wiring.

Inspection point	Terminals	Standard	Circuit tester range
RAP	Both terminals of RAP	Approx. 25 Ω	Ω x 1



Continuity Inspection



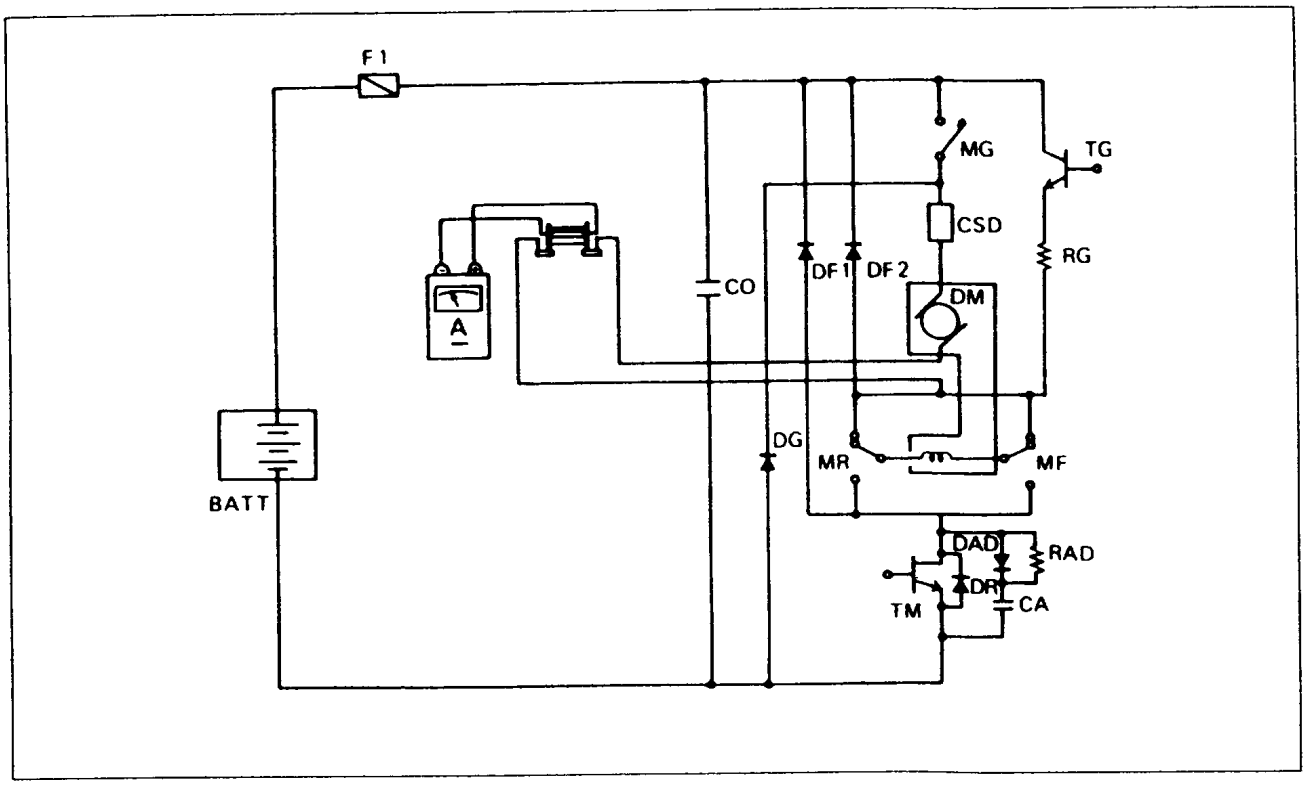
Inspection Method

Inspection point		Standard	Circuit tester range
Between P2 and N1	P2: ⊕ probe —— N1: ⊖ probe	Approx. 10 ~ 20 Ω	Ω x 1K
	P2: ⊖ probe —— N1: ⊕ probe	* ∞ Ω	
Between P12 and N1	P12: ⊕ probe —— N1: ⊖ probe	Approx. 10 ~ 20 Ω	Ω x 1K
	P12: ⊖ probe —— N1: ⊕ probe	* ∞ Ω	
Between P2 and frame	P2: ⊕ probe —— Frame: ⊖ probe	∞ Ω	Ω x 1K
Between N1 and frame	Circuit tester probes may be used in either direction.	∞ Ω	Ω x 1K

* Since the capacitor is charged in the first inspection, the pointer indicates the capacitor characteristic.
  Capacitor characteristic: The pointer deflects to 0 Ω first and returns to ∞ Ω then.

OCL VALUE (OVERCURRENT LIMIT VALUE)

1. Drive circuit OCL value measurement
   (1) Measurement
   Lock the drive wheels in the operation state and insert a shunt in the drive motor circuit for measurement.
   (The parking brake and foot brake shall be released.)



Model	FBMF16	FBMF20·25	FBMF30
Standard OCL value	380 ±19 A	380 ± 20 A	440 ± 25 A

Shunt: 50 mV, 500 A

(2) Method for judgement
If the OCL value is outside the standard, make judgement as follows since it may be caused by a defect of the drive circuit current sensor (CSD) or CPU board:

① Jack up the vehicle until the drive wheels depart from the ground, and support both sides of the frame with wooden blocks.
② Activate the analyzer mode and select category 1 and class 2 (test operation). Set the monitor item No. to 0. (See page 5-21.)
③ Drive the engine with a fixed accelerator pedal depression angle. After the revolution is stabilized, compare the value indicated on the display with the value measured with a shunt.

Standard: **If the difference between the displayed value and measured value is within ±5%, judge the current sensor to be normal.**

When the current sensor is judged normal, replace the CPU board because it is considered defective.

Caution:
Never tamper with the OCL adjusting trimmer on the CPU board.

2. Material Handling Circuit OCL Value Measurement
   The OCL value cannot be measured by the following reason:

When the cylinder in the hydraulic system reaches to the stroke end, the pressure build up even greater accompanied by the uprising of electric current.

The relief value in the oil control valve, however, will prevent the system from further uprising.

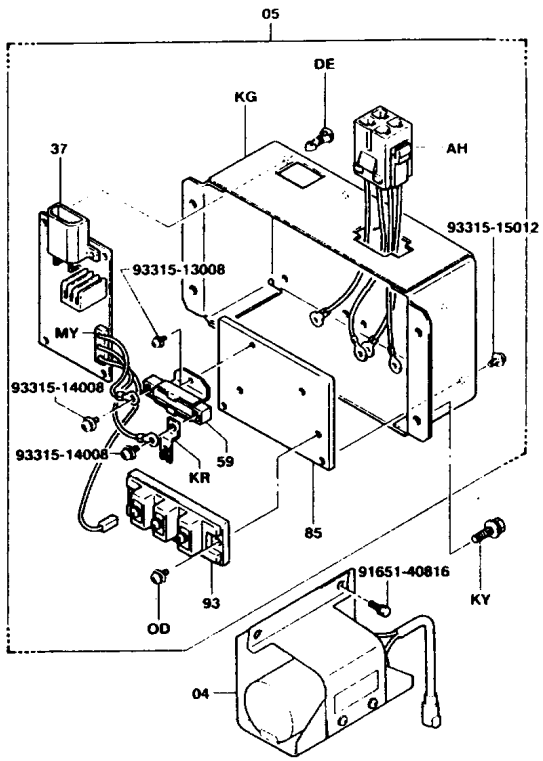
OCL value is set greater than the maximum current value corresponding to the stroke end.

There is no more current rise after the relief; therefore the OCL value cannot be measured.

EPS CONTROLLER

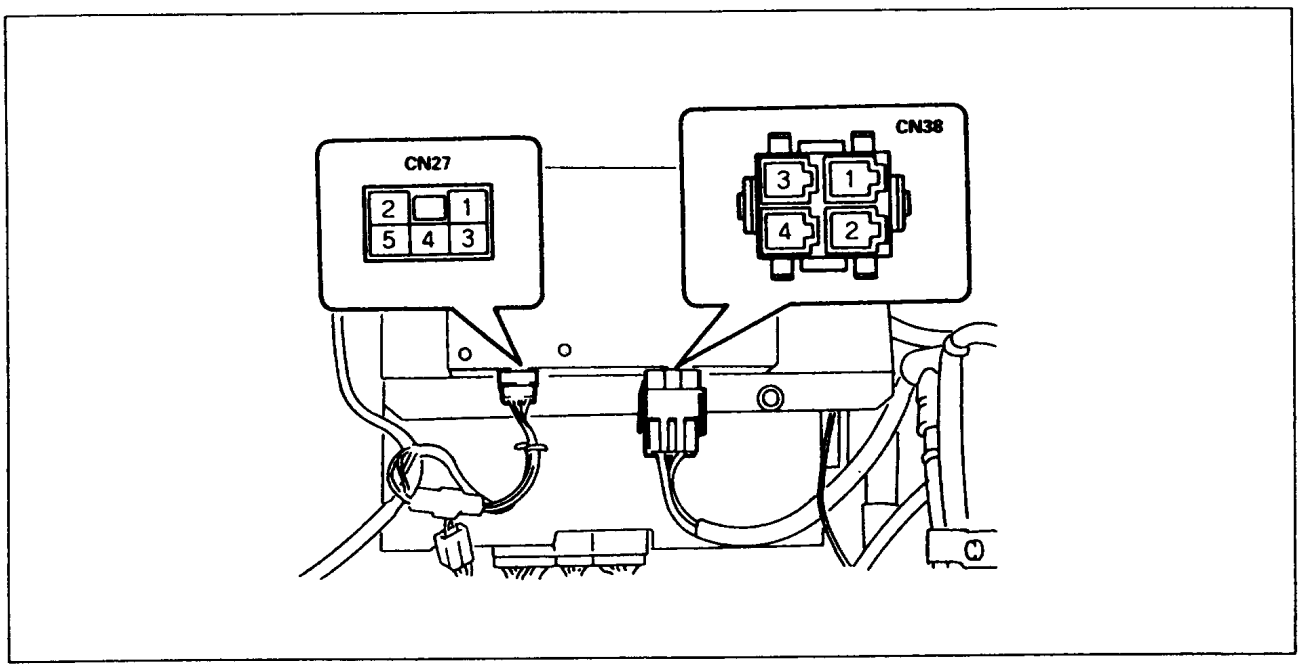
COMPONENTS

2401



ON-VEHICLE INSPECTION

1. Insulation resistance mesurment (See page 4-7).
2. EPS controller
   When the cause of a trouble is judged to exist in the EPS controller, apply the battery voltage and measure the voltages applied to each connector.



CN27 Connector: Basic conditions (battery plug ON and key switch ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 27-1 (43, +48V)	CN 27-5 (163, GND)	Key switch ON	Approx. 48 V	
		Key switch OFF	0 V	
CN 27-3 (161, +15V)	CN 27-5 (163, GND)	Key switch ON	15 ± 0.8 V	
		Key switch OFF	0 V	
CN27-2 (162, ST)	CN27-5 (163, GND)	Wheel fully rotated position (held at end position)	11.5 V or more	
		Wheel not operated (stopped state)	3.5 V or less	

CN38 Connector: Basic condition (battery plug ON)

Connector No. ← → Connector No.		Condition	Standard	Remarks
CN 38-3 (P21, +80 V)	CN 38-4 (N1, GND)		Approx. 72 V (For 72 V battery) Approx. 80 V (For 80 V battery)	

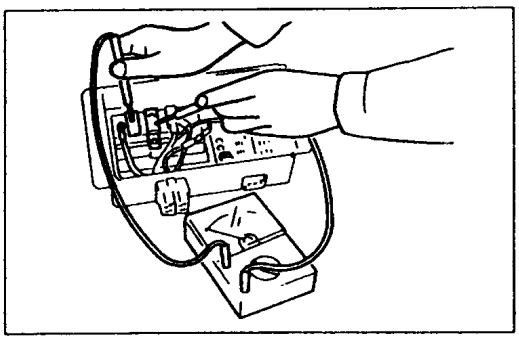
REMOVAL·INSTALLATION

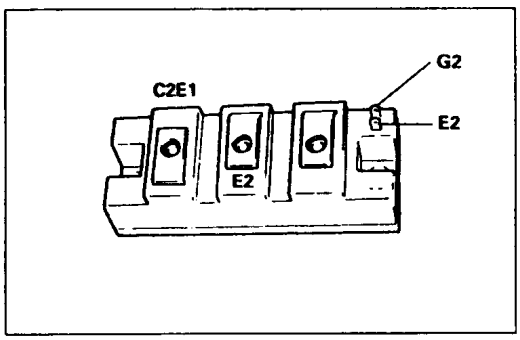
Refer to page 4-16 for MCS-Ⅱ CONTROLLER REMOVAL·INSTALLATION.

Inspection

1. TM_{PS} (main transistor, power steering)
   (1) Inspection method
   Disconnect the TM_{PS} wiring.

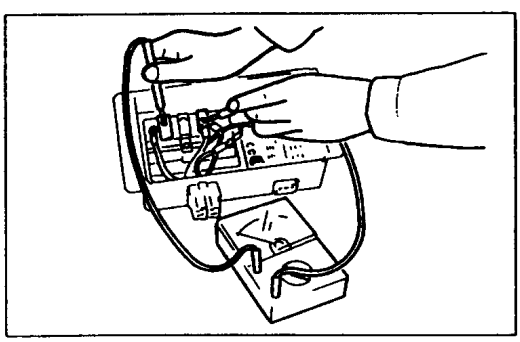
Inspection point	Terminals		Standard	Circuit tester range
TM_{PS}	Between C2E1 and E2	C2E1 ⊖ probe ——— E2 ⊕ probe	∞ Ω	Ω x 1K
		C2E1 ⊕ probe ——— E2 ⊖ probe	Continuity shall exist.	
	Between G2 and E2	G2 ⊖ probe ——— E2 ⊕ probe	∞ Ω	
		G2 ⊕ probe ——— E2 ⊖ probe	∞ Ω	

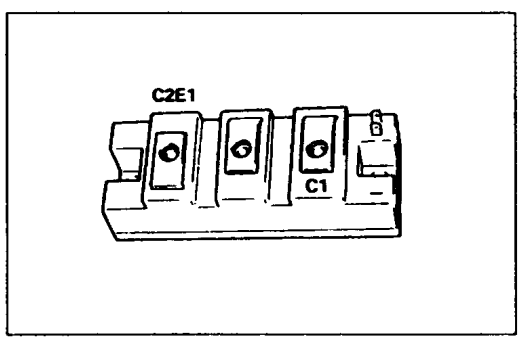




2. DF4 (flywheel diode No.4)
   (1) Inspection method
   Disconnect the DF4 wiring.

Inspection point	Terminals	Standard	Circuit tester range
DF4	Forward: Anode (C2E1): ⊖ probe ——— cathode (C1): ⊕ probe	Continuity shall exist.	Ω x 1K
	Reverse: Anode (C2E1): ⊕ probe ——— cathode (C1): ⊖ probe	∞ Ω	

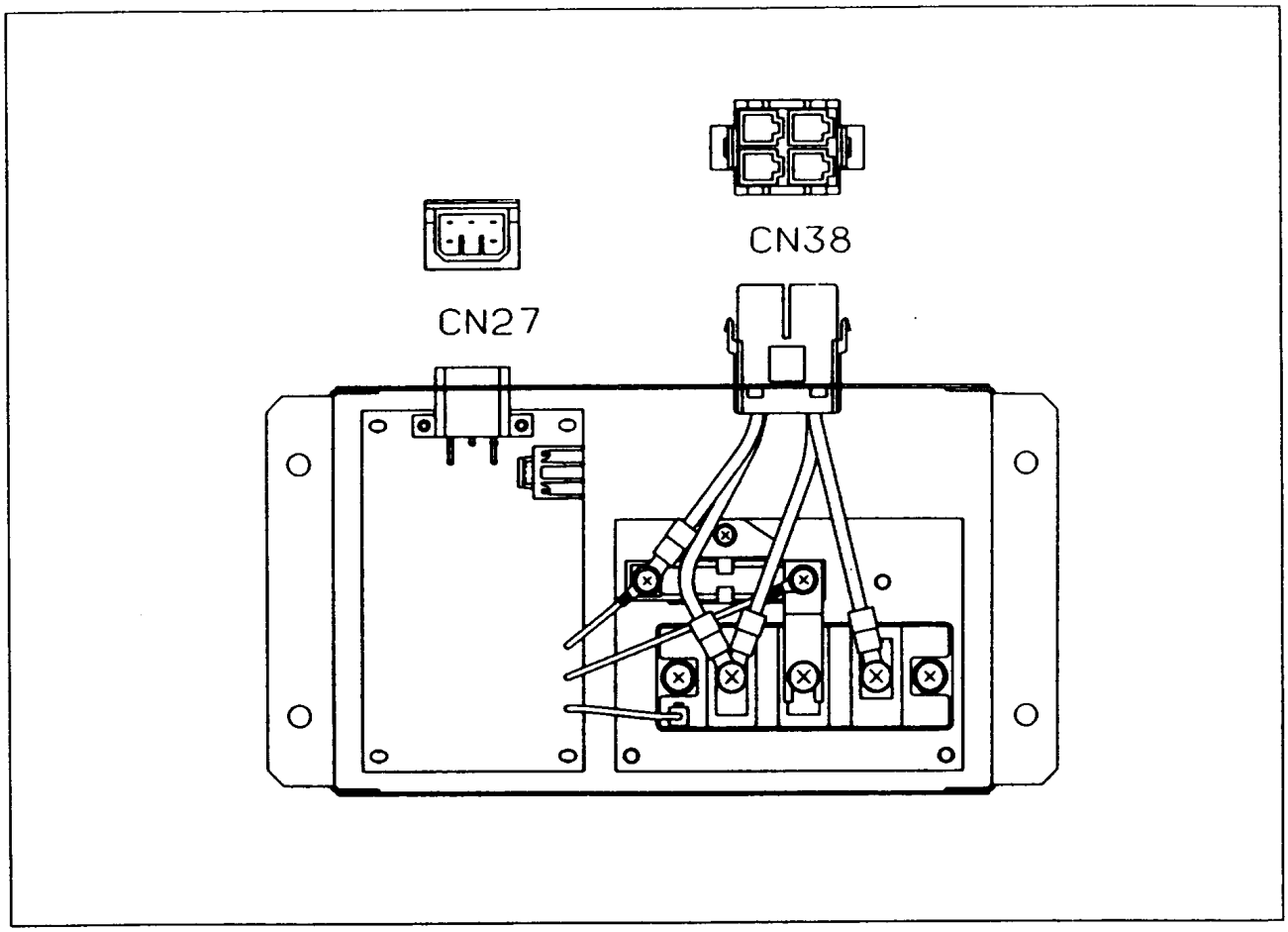




DISASSEMBLY·REASSEMBLY

Note:

- **Before disconnecting the harness, always record the mounting position or put a tag showing the position. Check the memo or tag at the time of connection to prevent incorrect installation or wiring. In correct installation or wiring will cause new troubles.**
- **After completion of installation, check no contact of the wiring at unnecessary places.**



Screw	Tightening torque N·m (kgf-cm) [ft-lbf]
M3	0.49 ~ 0.88 (5 ~ 9) [0.36 ~ 0.65]
M4	0.98 ~ 1.96 (10 ~ 20) [0.72 ~ 1.45]
M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]

3. EHPS

OUTLINE

EHPS (Electronically Controlled Full Hydraulic Power Steering) is adopted in some counterbalanced electric powered forklift models (5FBE, FBMF, etc.).

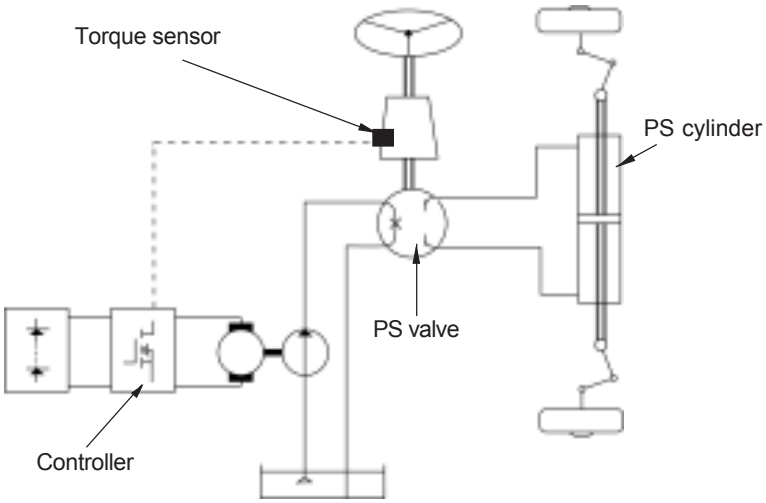
A mechanism that electronically controls the pump motor rotation for hydraulic pressure generation is added to the hydrostatic type power steering to make the motor run only during steering operation so as to save energy.

When the steering wheel is rotated, the rotating torque is detected by a torque sensor which sends an electric signal to the controller. The controller receives the signal and sends the corresponding chopping instruction for motor rotation to a transistor.

The hydraulic components of the hydrostatic type power steering mechanism in the EHPS are not explained here because they are almost the same in structure and function with those explained elsewhere.

The chopping control for motor rotation varies with the model.

It is roughly classified into the type using an electrical torque sensor (FBMF series) and the type using an oil pressure switch at the steering oil control valve (5FBE series).

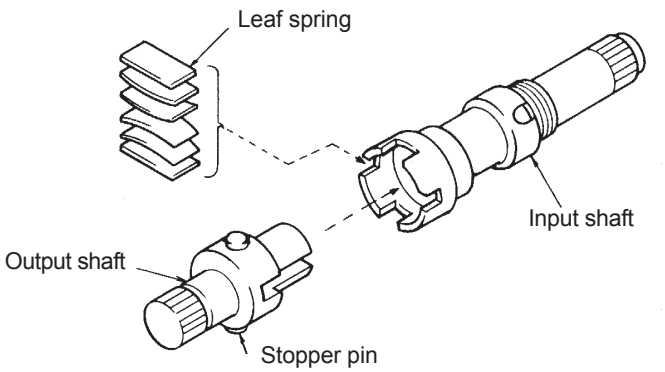


EHPS FOR FBMF SERIES

1) Torque Sensor

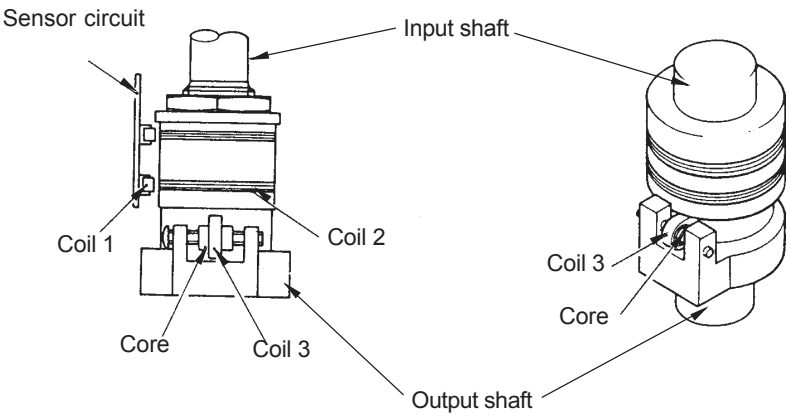
The torque sensor consists of the mechanical block that provides displacement between the input and output shaft rotation angles according to the rotating torque generated by steering wheel rotation and the sensor block that generates an electric signal according to the angle displacement.

The mechanical block consists of the input shaft directly rotated by the steering wheel rotating torque, output shaft connected to the power steering control valve, and the leaf spring for retaining the neutral position.



Torque Sensor Mechanical Block

When the steering wheel is in its neutral position, the input and output shafts are held in the neutral position by the leaf spring. When the input shaft is rotated by the steering wheel, the output shaft is not rotated immediately because of the reaction force from the tires transmitted through the control valve. As a result, an angle difference is generated. This difference is converted to an electric signal in the sensor block explained below.



2) Sensor Block

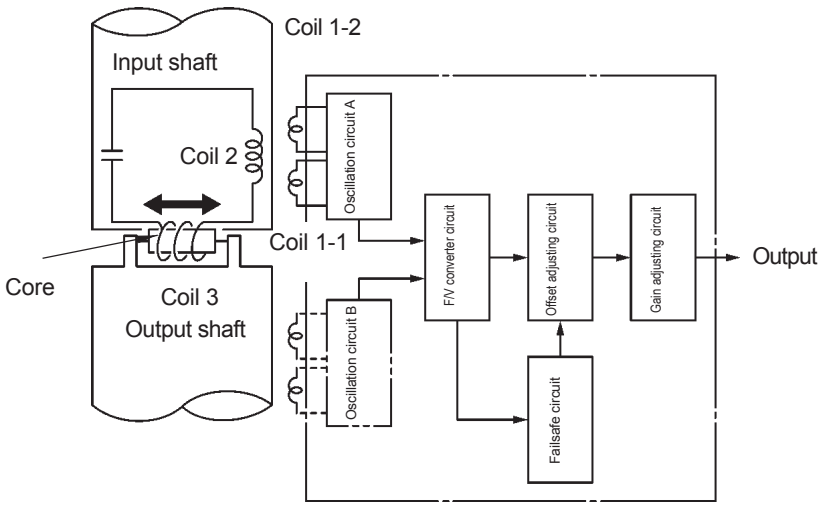
The sensor block consists of the resonance circuit and the sensor circuit.

In the sensor circuit, an electrical vibration (oscillatory current) flows through coil 1-1 in each of oscillation circuits A and B. When the oscillatory current flows through coil 1-1, a current is generated in coil 2 by the induced electromotive force and it flows through the resonance circuit including coil 3 and a capacitor.

In the resonance circuit, variation in the positional relationship between coil 3 and the core (due to torsional angle difference between the input and output shafts) changes the oscillation frequency and amplitude. As a result, coil 1-2 provided opposite to coil 2 can receive a signal corresponding to the positional relationship between coil 3 and the core.

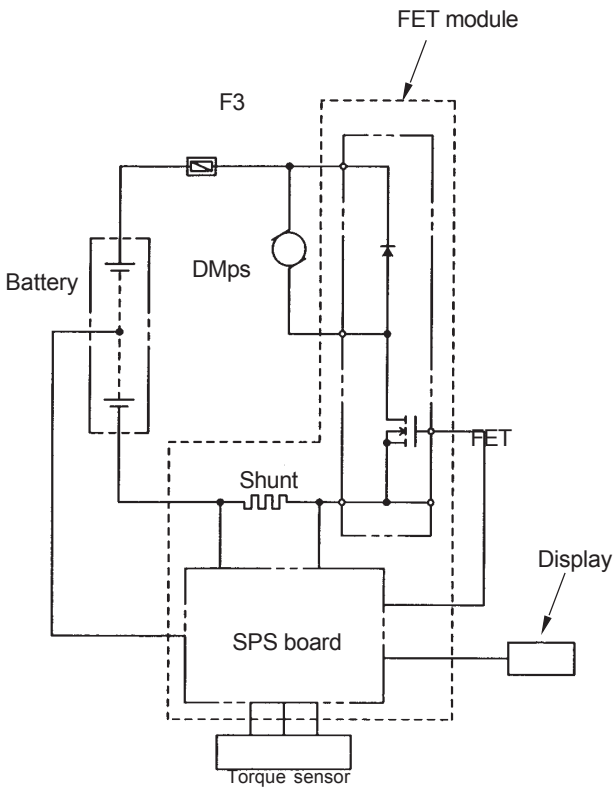
In this way, the sensor circuit provides an output representing the torsional angle difference between the input and output shafts.

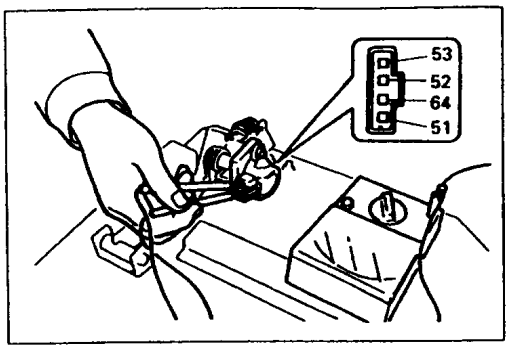
Two pairs of resonance circuits are provided on the shafts, to which oscillation circuits A and B correspond. This configuration minimizes the influence of temperature on the torque sensor characteristic.

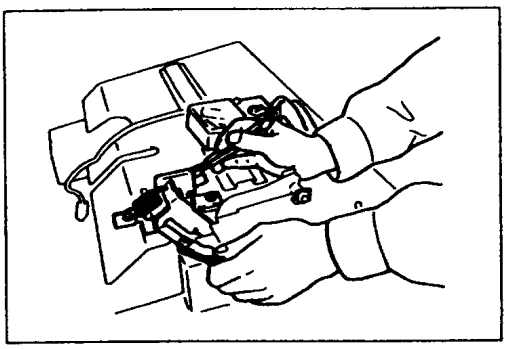


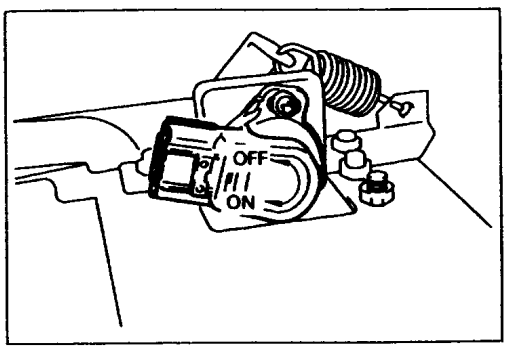
3) Controller

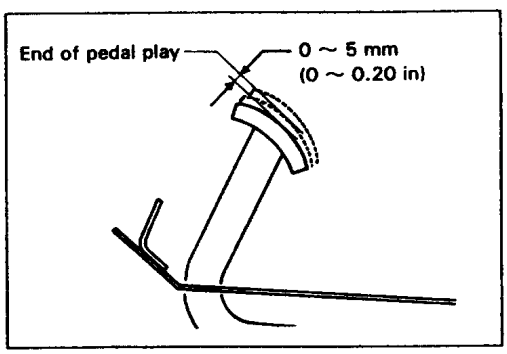
The controller makes the motor run whenever necessary at the required speed by chopping the FET according to the output from the torque sensor.











ACCELERATION POTENTIOMETER ADJUSTMENT

Make adjustment in the state of acceleration potentiometer W/toe board.

1. Operate the accelerator pedal and check if the acceleration switch is turned ON and OFF.
   Measurement terminals: 51 and 64
   Standard
   When the pedal is not depressed: ∞ Ω
   When the pedal is depressed: 0 Ω

2. Acceleration potentiometer installation adjustment
   (1) Insert a 1.5 mm (0.059 in) thickness gauge between the accelerator link stopper and toe board.
   (2) Temporarily install the potentiometer so that the switch (SW_{AC}) is set to ON.
   (3) Inspect the switch (SW_{AC}) ON and OFF changeover points.
   When 1.0 mm (0.04 in) thickness gauge is inserted: OFF
   When 2.0 mm (0.08 in) thickness gauge is inserted: ON
   (4) After the end of switch ON-OFF adjustment, fully tighten the set screws.

   T = 1.57 ~ 2.35 N·m (16 ~ 24 kgf-cm) [1.16 ~ 1.74 ft-lbf]

   Reference resistance value: Vc(53) – E2(51)
   Approx. 2.6 kΩ

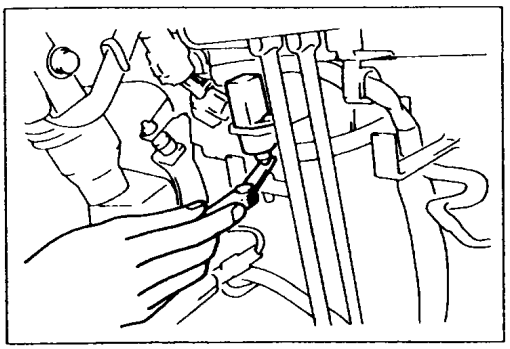
BRAKE SWITCH ADJUSTMENT

Note:
- **The regenerative brake switch is installed on the LH side.**
- **The stop lamp switch is installed on the RH side. See page 12-33 for the switch adjustment procedure.**

1. Check and adjust the brake pedal play.
   (See page 12-33)

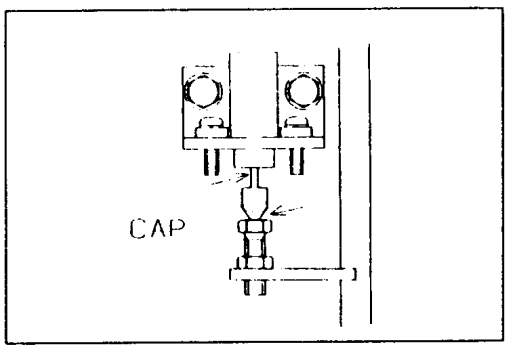
2. Adjust so that the switch is turned ON within 0 to 5 mm (0 to 0.20 in) after the brake pedal play is eliminated.

   Note:
   Make adjustment by bending the switch bracket.

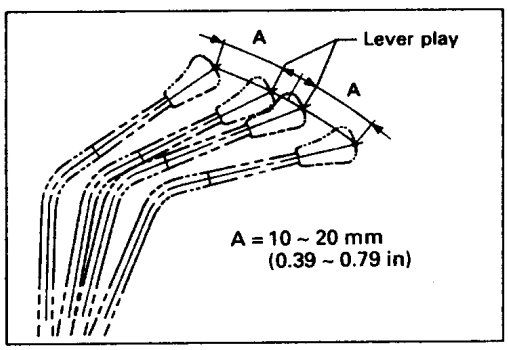


LIFT POTENTIOMETER ADJUSTMENT

1. Fit the cap at the stroke sensor fully to the depth.
2. Pull the lift lever as much as its looseness from the neutral position.
3. Determine the adjusting bolt position to push the cap at the sensor in by 0 to 1 mm (0.039 in).



4. Coat MP grease at the position indicated by the arrow in the illustration.



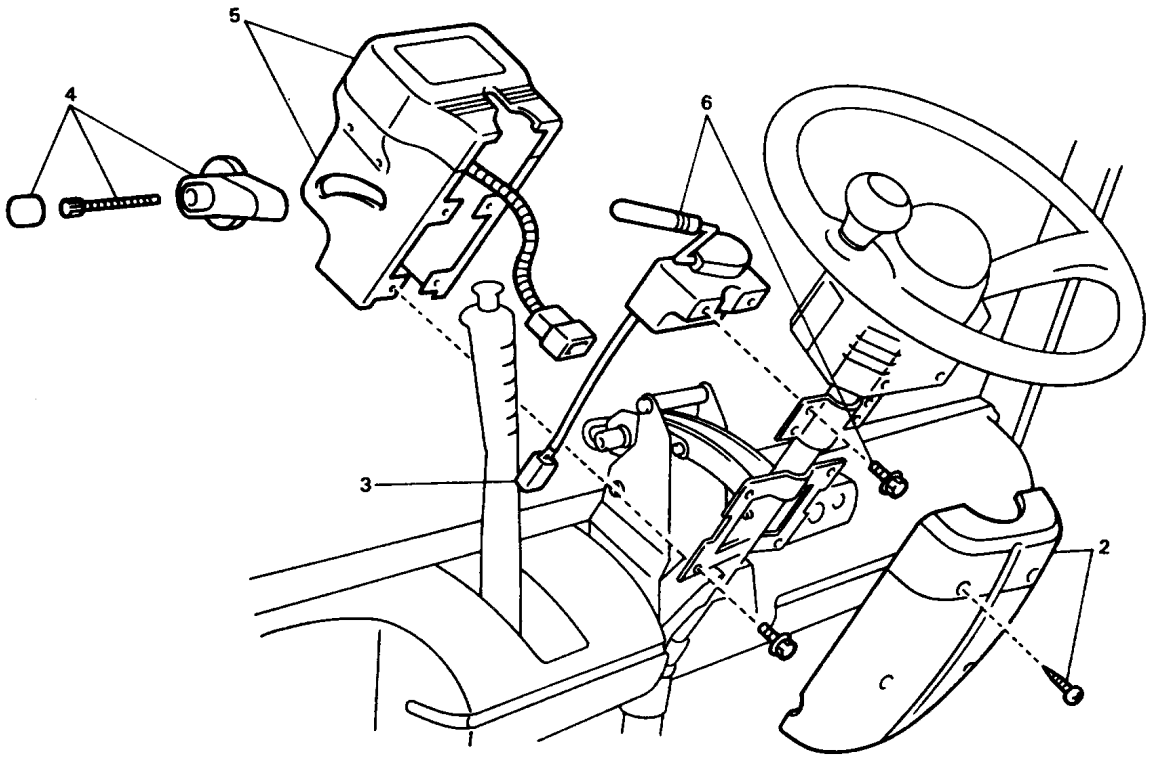
MATERIAL HANDLING LEVER SWITCH ADJUSTMENT

1. Make adjustment so that the switch is turned ON within A = 10 to 20 mm (0.39 to 0.79 in) after each lever play is eliminated.

Note:
Make adjustment by changing the switch installed position.

DIRECTION SWITCH

REMOVAL·INSTALLATION



1 Battery plug

Removal Procedure

1 Disconnect the battery plug.

2 Remove the steering rear cover.

3 Disconnect the direction switch connector.

4 Remove the steering tilt lever.

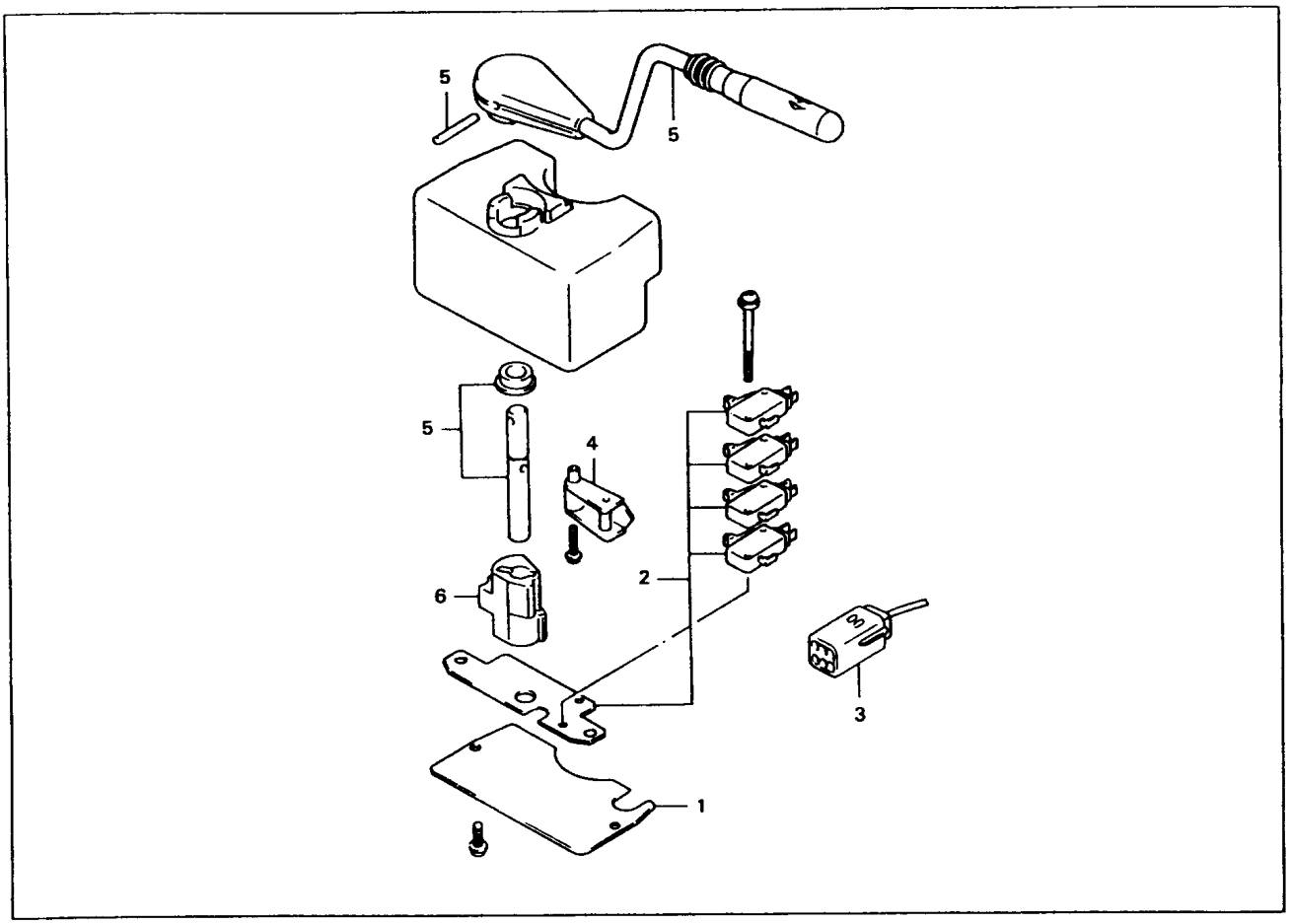
5 Remove the steering front cover and combination meter.

6 Remove the direction switch.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

DISASSEMBLY·REASSEMBLY



Disassembly Procedure

1 Remove the plate.

2 Remove the microswitch W/wire harness. **[Point 1]**

3 Remove the micro switch base.

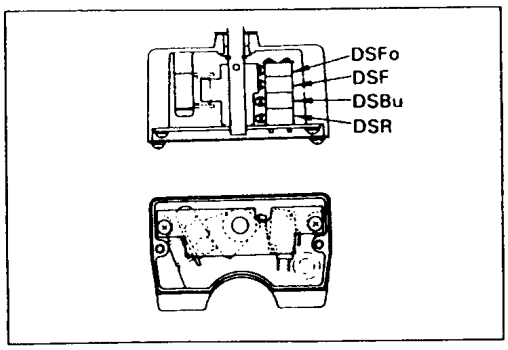
4 Remove the cam roller and spring.

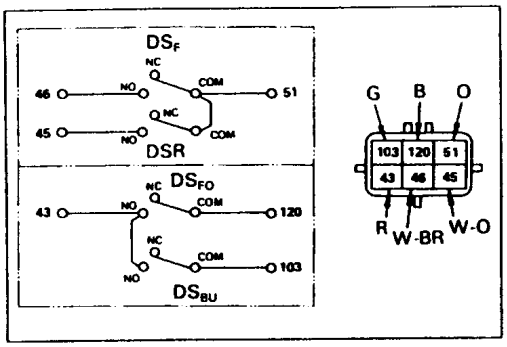
5 Remove the direction lever W/knob.

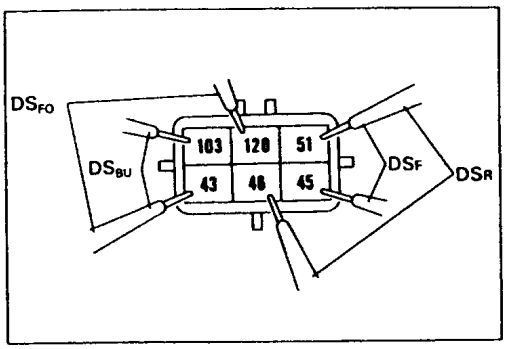
6 Remove the cam.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.







Point Operation

[Point 1]

Reassembly: 1. Install the microswitches in the correct positions.

2. When replacing a microswitch, connect the cables according to the cable colors in the figure.

INSPECTION

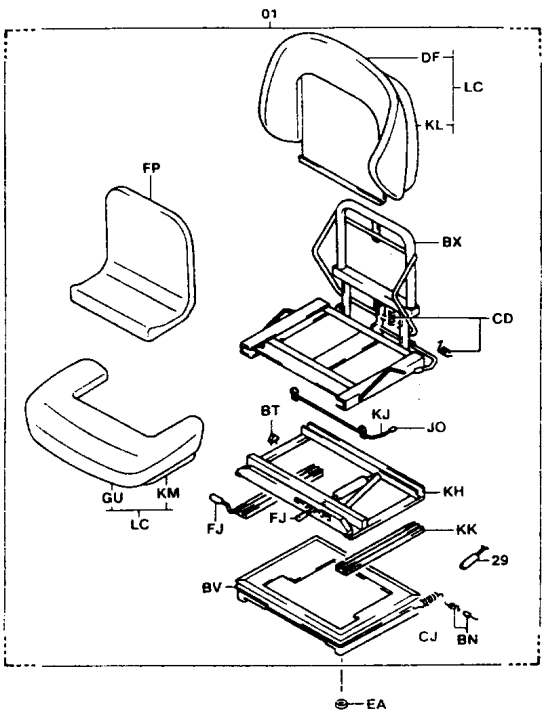
After assembling the direction switch, check conduction of each microswitch before installing the direction switch.

Standards	Lever position		
Inspection point	Neutral	Forward	Reverse
DSF	∞ Ω	0 Ω	∞ Ω
DSR	∞ Ω	∞ Ω	0 Ω
DSFO	∞ Ω	0 Ω	∞ Ω
DSBU	∞ Ω	∞ Ω	0 Ω

SEAT SWITCH

COMPONENTS

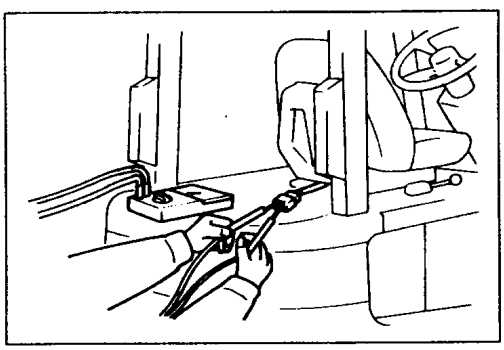
5308



INSPECTION

1 Seat switch individual inspection
Basic conditions (battery plug OFF and disconnect CN20 connector)

Measurement terminals	Bolts terminals of CN20 connector
Circuit tester range	Ω × 1
Standard	When seated: 0 Ω, When not seated: ∞ Ω



MULTI-DISPLAY FUNCTIONS

5

GENERAL

The FBMF series is provided with the diagnostic function for displaying the defective portion in the vehicle by the corresponding code when a vehicle trouble occurs and the mask function to be used by the service personnel for vehicle maintenance in addition to ordinary display by the multi-display functions.

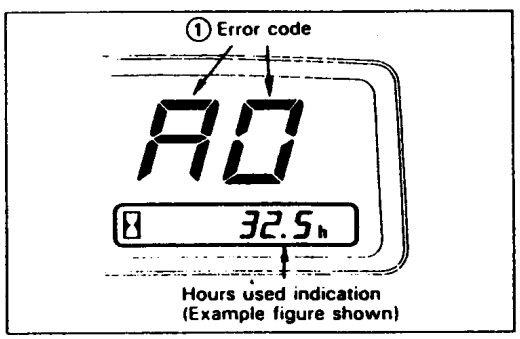
DIAGNOSIS

GENERAL

The FBMF Series has the self diagnostic function, which automatically detects errors in the main drive and material handling circuits, operation systems such as the accelerator, sensors, etc., and sounds the buzzer while displaying these errors by corresponding error codes on the multi-display.

At the same time, safe operation is ensured by automatically stopping traveling, stopping material handling and controlling the traveling speed.

Depending on the trouble only the error code appears on the multi-display. Although the vehicle may be operated, make necessary repairs as soon as possible.



1. Error code display
   The error code appears in part ① in the illustration, and the warning sound bleeps. Make repairs soon according to the error code displayed by self diagnosis while referring to "Troubleshooting" in Repair Manual.

DIAGNOSTIC ERROR CODE LIST

Error code (See page)	Defective part	Failure mode	Fail-safe
A0 (6-4)	MCS main circuit	Overheat	Maximum traveling speed is 5 km/h (3 mph)
A1 (6-6)	MCS main circuit	Overvoltage	Stopping of traveling and material handling
A2 (6-8)	CPU board	Abnormal temperature rise	Maximum traveling speed is 5 km/h (3 mph)
A4 (6-9)	Traveling accelerator	Accelerator potentiometer abnormality	Traveling stops
A5 (6-11)	Brake	Brake switch abnormality	Traveling stops
A6 (6-13)	Material handling accelerator	Lift switch abnormality	Material handling stops
A8 (6-16)	Traveling system fuse F1	F1 fuse open	Stopping of traveling and material handling
A9 (6-20)	Material handling system fuse F2	F2 fuse open	Material handling stops
AA (6-21)	CPU board	Temperature sensor abnormality	Display only
AE (6-21)	CPU board	Excessive analog input detection and processing time	Stopping of traveling and material handling
AF (6-21)	CPU board	CPU processing date abnormality	Stopping of traveling and material handling
C0 (6-22)	Main drive circuit	TMD short circuit TMD open circuit Traveling SD board abnormality	Traveling stops
C1 (6-30)	Traveling current sensor	Current sensor harness short or open circuit	Traveling stops
C3 (6-32)	Controller temperature sensor	Temperature sensor harness short or open circuit	Maximum traveling speed is 5 km/h (3 mph)
C4 (6-34)	Traveling accelerator	Accelerator potentiometer short circuit Accelerator potentiometor open circuit	Traveling stops
C7 (6-37)	Direction switch	Switch short circuit	Traveling stops

Error code (See page)	Defective part	Failure mode	Fail-safe
C8 (6-38)	Speed sensor	Sensor harness open circuit	Traveling stops
C9 (6-40)	MG contactor	MG contactor short circuit	Traveling stops
CA (6-44)	MF and MR contactors and their operating circuit	MF or MR contactor coil open circuit, or coil chopper transistor short or open circuit	Traveling stops
CC (6-46)	CPU board Traveling OCL circuit	Traveling OCL value abnormal drop	Display only
CE (6-46)	CPU board	ROM abnormality	Stopping of traveling and material handling
CF (6-46)	CPU board	RAM abnormality	Stopping of traveling and material handling
E0 (6-47)	Material handling circuit	TMP short circuit TMP open circuit Material handling SD board abnormality	Material handling stops
E1 (6-54)	Material handling current sensor	Current sensor harness short circuit or open circuit	Material handling stops
E6 (6-56)	Material handling accelerator	Lift potentiometer short circuit Lift potentiometer open circuit	Material handling accelerator runs at max. speed
EA (6-57)	MB contactor and its operating circuit	MB contactor coil open circuit, or coil chopper transistor short or open circuit	Material handling stops
EC (6-59)	CPU board Material handling OCL circuit	Material handling OCL value abnormal drop	Display only
EE (6-59)	Display ~ MCS communication system	MCS received date abnormality	Display only
EF (6-59)	CPU board	CPU processing time abnormality	Display only
F0 (6-60)	Power steering	EPS controller	Display only
F1 (6-62)	Display ~ MCS communication system	Communication failure	Display only
F2 (6-62)	Display ~ MCS communication system	Communication data defect	Display only
F3 (6-62)	Display ~ MCS communication system	Improper communication data	Display only
F4 (6-62)	Display	Power control memory value abnormality	Display only

MASK FUNCTIONS

GENERAL

The mask functions are used by the service mechanic in servicing the vehicle.
It is, therefore, necessary to input the password from the switch panel to prevent erroneous operation by general users.

Mask function table

Item	Description	To be used
Option setting ※1	Select whether to enable or the disable demonstration	At the time of new vehicle demonstration before starting the hour meter
Hour meter start ※2	Starting incrementation of the hour meter	• At multi-display board replacement • Vehicle delivery
Analyzer	Checking the state of each part of the vehicle and displaying the result in the corresponding alphanumeric code (See the Analyzer section.)	At inspection on repair of the vehicle
MCS-II tuning	Adjusting soft start, etc. by switch operation	• Upon request from the user • At multi-display board replacement (only when tuning mode is changed)
Tire constant rewriting	Correcting the speedometer	• Upon tire replacement with another type • At multi-display board replacement
Unit changeover (km/h·km – mph·mile)	Selecting the unit for display of speed and distance	At multi-display board replacement
Power control input (lock – unlock)	Disabling switch input other than password	Upon request from the user
Battery ※3 (mounted – not mounted)	Correcting the battery capacity indicator	At multi-display board replacement (Only battery not mounted)

※1: Option setting (Demo)
It is possible to enable simultaneous traveling and material handling of the vehicle temporatily before starting the hour meter.

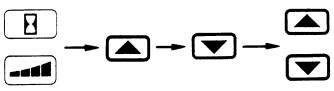
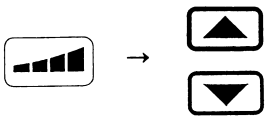
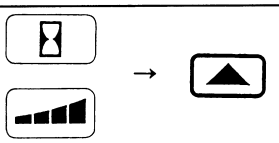
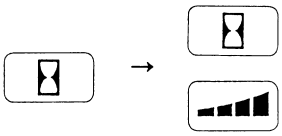
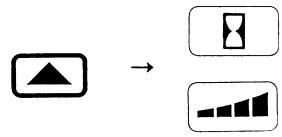
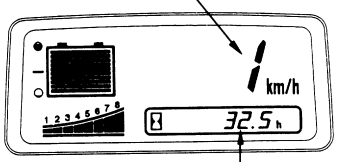
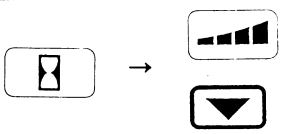
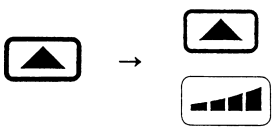
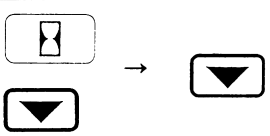
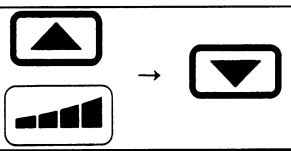
※2: Hour meter start
The hour meter does not start counting when a vehicle is shipped. Before vehicle delivery to the user, the dealer is requested to start the hour meter without fail.

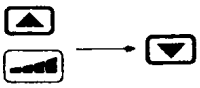
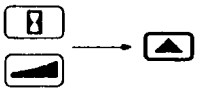
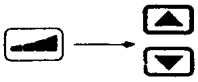
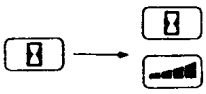
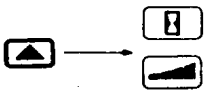
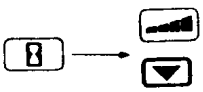
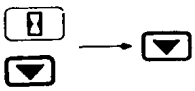
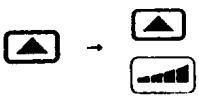
Note:
- **Once started, the hour meter can no longer be stopped.**
- **The controller automatically disables simultaneous traveling and material handling operations until the hour meter is started.**
  (The material handling operation is disabled even when material handling is tried during traveling. When traveling is started during material handling, the material handling operation is stopped. The priority is given to traveling in this case.)

Programmering och felsökning

Inknappning av lösenord

Varning!
Palla alltid upp drivhjulen vid test och felsökning.

Primärt lösenord	Lösenord accepterat	Sekundärt lösenord	Funktion
 Tryck samtidigt / Tryck samtidigt och håll kvar i 2 sekunder	**OBS!** Sekundärt lösenord måste knappas in inom 10 sek!		Analyzer Sid. 5-8
			Start av timmätare
			MCS-II Tuning Sid. 5-29
	En 1:a här indikerar att lösenordet är OK		Kompensation av drivhjulsdiameter Sid. 5-32
	 Nyckeltimmar som maskinen använts		Enhet för hastighet km ↔ mile
Ett kort "pip" hörs efter varje knapptryckning!			Batterityp "Mounted" = T0 "Not Mounted" = T1 Sid. 5-33
Slå av/till nyckeln och börja om från början om det inte lyckas.			
			Lås för effektvalsknapp Låst=P1 Olåst=P0
			Option Sid. 5-7

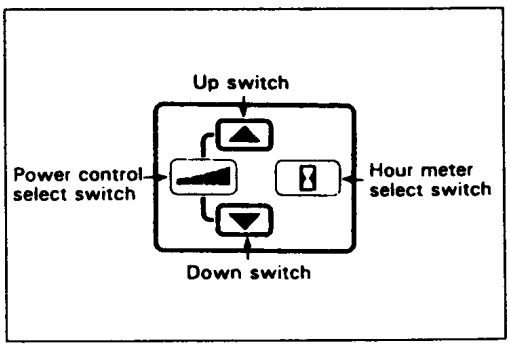
Item	Secondary password	Processing
★ Option setting		Option setting activation (See page 5-7)
Hour meter start		Hour meter starting
★ Analyzer		Analyzer activation (See page 5-8)
★ MCS-Ⅱ tuning		MCS-Ⅱ tuning activation (See page 5-29)
★ Tire constant rewriting		Tire constant rewriting activation (See page 5-32)
Speedometer units changeover		Every time of inputting the password: km/h·km ⇄ mph·mile
Power control input (See page 5-33)		Every time of inputting the password: Unlock (display: P0) ⇄ Lock (display: P1)
Battery (See page 5-33)		Every time of inputting the password: Mounted (display: T0) ⇄ Not mounted (display: T1)

For items with ★, follow the operation procedure on the reference page after inputting the secondary password.
For other items, processing is completed by secondary password input.

OPTION SETTING

GENERAL

It is possible to enable simultaneous traveling and material handling of the vehicle temporarily before starting the hour meter. Always set to disable, therefore, when it becomes unnecessary.



USING OPTION SETTING

1. Input to the passwords according to the Password input method on page 5-6.
2. Select enable or disable by the Up or Down switch.
   Up switch ····· Enable (Display: y)
   Down switch ····· Disable (Display: no)
3. Press the Power control select switch to end selection.

ANALYZER

GENERAL

The analyzer supports controller system inspection and locating of defective parts by making full use of the computer function of the MCS-II controller and the communication function between MCS-II and multi-display.

(1) Monitoring the history of past errors (diagnosis monitor)

(2) Testing the connections and insulation defects of wiring and connectors (switch input test)

(3) System check with actual travel and material handling operations (test operation)

Test items by analyzer

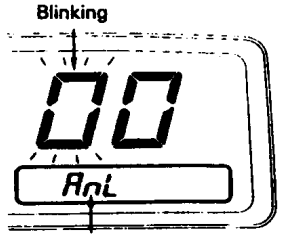
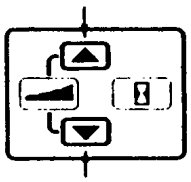
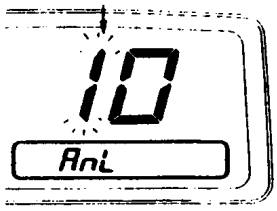
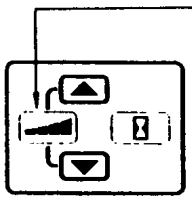
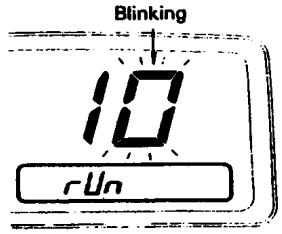
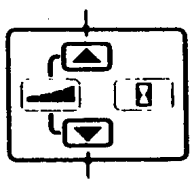
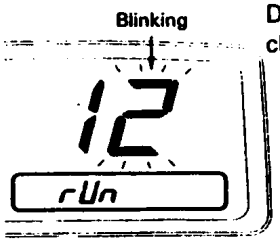
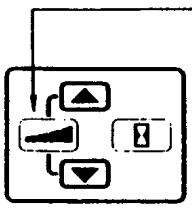
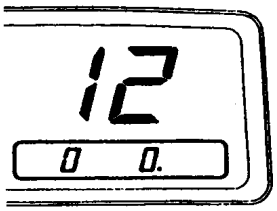
Category		Class		Description
1	Simple test and test operation	1	Simple test	Past diagnosis display and continuous quality check for main circuits, switch systems and sensor systems
		2	Test operation (voltage, current and temperature display)	Test operation while checking analog input values (motor current, accelerator input voltage, etc.) and error occurrence
		3	Test operation (traveling speed display)	Test operation while checking analog input values (traveling speed) and error occurrence
2	Diagnosis monitor	1	Diagnosis monitor	Past error display with hour meter readings at the time of error occurrences
3	Switch input test	1	Switch ON/OFF information display	Display of each switch ON/OFF state
		2	Buzzer check	Information of one switch ON/OFF state by buzzer sound
		3	Momentary interruption test	Testing defective contacts of wirings and connectors
		4	Short circuit test	Testing defective insulation of wirings and connectors

USING ANALYZER FUNCTION

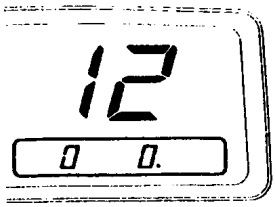
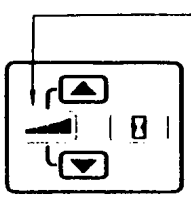
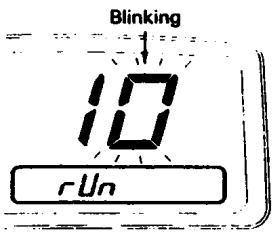
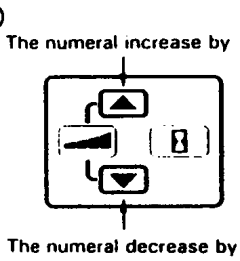
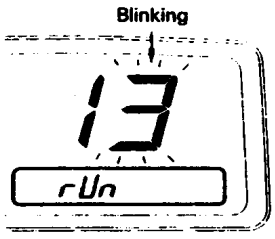
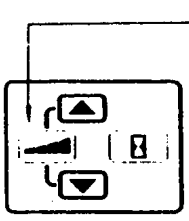
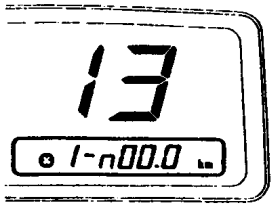
1. Input the passwords to display the analyzer initial screen. (See page 5-6)

2. Input the test item number.

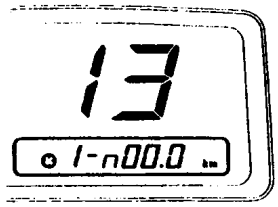
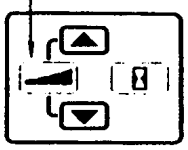
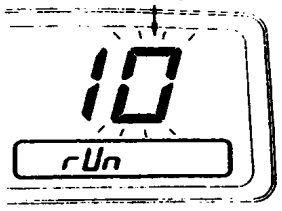
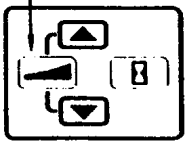
(1) Item selection from initial screen. (Example: 1-2)

Step	Operation method	Screen display
Initial screen	① End of analyzer activation	Blinking  Anl: analyzer Indicates the ready state for category number input.
Category selection	② The numeral increase by 1  The numeral decrease by 1	Blinking  Display the desired category number
	③  Press the power control select switch when the desired category number is displayed.	Blinking  The category number is determined and class number input is enabled.
Class selection	④ The numeral increase by 1  The numeral decrease by 1	Blinking  Display the desired class number.
	⑤  Press the power control select switch when the desired class number is displayed.	 Blinking stops when the class number is determined to complete item selection.

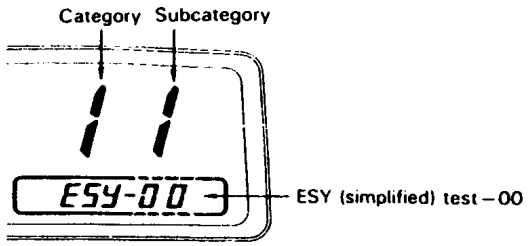
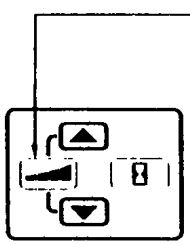
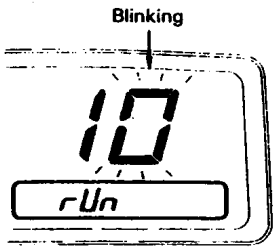
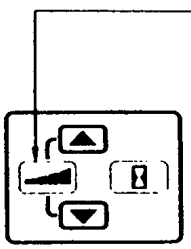
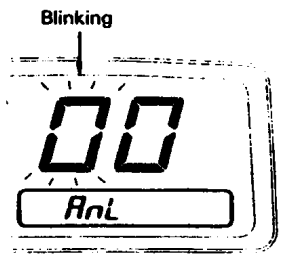
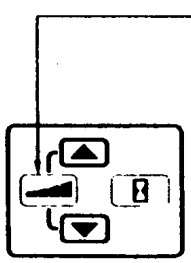
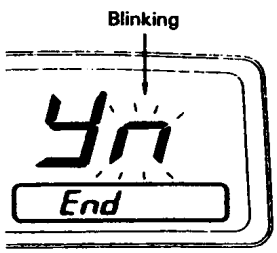
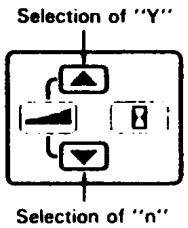
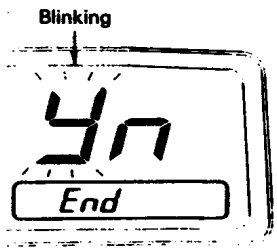
(2) To select another item.
(a) To select another class in the same category (Example: 1-2 → 1-3)

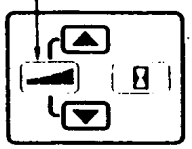
Step	Operation method	Screen display
Test screen	① State of testing an certain item (12)	
End of test	②  Press the power control select switch to end the test.	 The item selection screen is displayed to enable class number input.
Class selection	③ 	 Display the desired class number.
	④  Press the power control select switch when the desired class number is displayed.	 Flashing stops when the class number is determined to complete item selection.

(b) To select an item in a different category (Example: 1-3 → New item)

Step	Operation method	Screen display
Test screen	① State of testing a certain item (13)	
End of test	②  Press the power control select switch to end the test.	Blinking  The item selection screen is displayed to enable class number input.
	③  Press the power control select switch to set class number 0.	 Returns to the initial screen upon analyzer activation when class number 0 is set.
Category and class selection	④ Select the desired item according to the procedure from "(1) Analyzer activation state (initial screen)".	

(3) Ending analyzer function

Step	Operation method	Screen display
Initial screen	① State of testing a certain item (11)	
End of test	②  Press the power control select switch to end the test.	 The item selection screen is displayed to enable class number input.
	③  Press the power control select switch and set class number 0.	 Returns to the initial screen upon analyzer activation when class number 0 is set.
Analyzer end screen	④  Press the power control select switch and set category number 0.	 "n" blinks. Analyzer mode completion confirmation Y: Yes to end the analyzer mode n: No to continue the analyzer mode
Analyzer end selection	⑤  Press the up switch and select Y (end the analyzer mode).	 "Y" blinks.

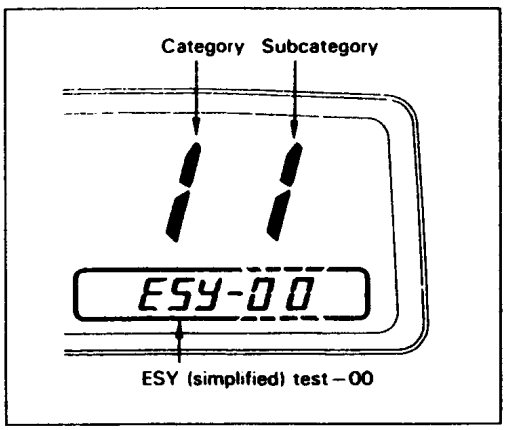
End of analyzer mode	⑥ Press the power control select switch to end the analyzer mode. 	

When the switch in step ⑥ is pressed in step ④ (blinking of "n"), the display returns to ① (initial screen).
It is also possible to end the analyzer mode by setting the key switch to OFF.

FUNCTIONAL EXPLANATION OF EACH TEST ITEM

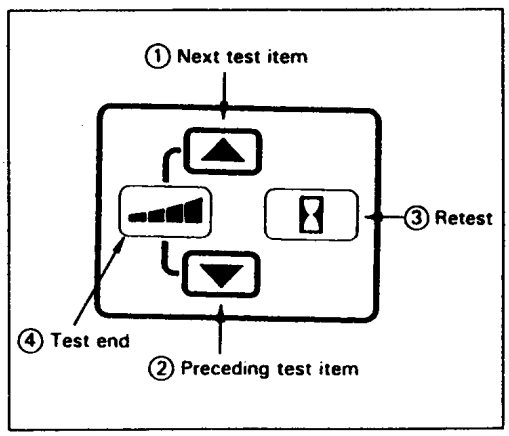
Category 1	Class 1	Simple test

The simple test consists of 34 test items ESY-01 to ESY-34, each with its own screen.



Simple test item selection method

1. Initial display



2. Switch operation method

Press ①: Proceeding to the next test item (Ex. ESY01 → 02)

Press ②: Returning to the preceding test item (Ex. ESY25 → 24)

Press ③: Repeating the same test item

Press ④: Ending the simple test (returning to the class selection screen)

Simple Test Function Table

Test No.	Description	
ESY-01	Automatically checking the battery state, main circuit, and current and speed sensors	
ESY-02	Reading the past diagnosis error memory (10 most recent records)	Most recent diagnosis error code and corresponding hour meter reading
ESY-03		Second most recent diagnosis error code and corresponding hour meter reading
ESY-04		Third most recent diagnosis error code and corresponding hour meter reading
ESY-05		Fourth most recent diagnosis error code and corresponding hour meter reading
ESY-06		Fifth most recent diagnosis error code and corresponding hour meter reading
ESY-07		Sixth most recent diagnosis error code and corresponding hour meter reading
ESY-08		Seventh most recent diagnosis error code and corresponding hour meter reading
ESY-09		Eighth most recent diagnosis error code and corresponding hour meter reading
ESY-10		Ninth most recent diagnosis error code and corresponding hour meter reading
ESY-11		Tenth most recent diagnosis error code and corresponding hour meter reading
ESY-12	Detected voltage value display (detecting function quality check based on the difference from the value actually measured with a circuit tester)	Detected voltage before key switch SW_{ky}
ESY-13		Detected voltage after key switch SW_{ky}
ESY-14		/ (not detectable because of MB contactor adoption)
ESY-15	Automatically judging abnormality or defective adjustment of drive accelerator, brake, material handling accelerator or lift switch by operating the accelerator, brake or lift levers	Checking accelerator switch SW_{AC} and drive accelerator variable resistor VRA
ESY-16		ON/OFF of brake limit switch LS_B
ESY-17	Automatically judging abnormality or defective adjustment of drive accelerator, brake, material handling accelerator or lift switch by operating the accelerator, brake or lift levers	Checking lift switch LS_L and material handling variable resistor VRAP

Test No.	Description	
ESY-18	Judging the temperature sensor quality automatically and by the difference between the detected temperature and actual temperature	
ESY-19	Checking the contactor and contactor drive qualities by outputting each contactor ON/OFF signal and visually checking the contactor close/open state	ON/OFF of forward contactor MF
ESY-20		ON/OFF of reverse contactor MR
ESY-21		ON/OFF of regenerative contactor MG
ESY-22		ON/OFF of power supply contactor MB
ESY-23	Judging switch and switch detection circuit qualities by each switch ON/OFF state display and buzzer sound	ON/OFF of forward switch DS_F
ESY-24		ON/OFF of reverse switch DS_R
ESY-25		ON/OFF of accelerator switch SW_{AC}
ESY-26		ON/OFF of brake switch SW_B
ESY-27		ON/OFF of speed control switch SW_{SC}
ESY-28		ON/OFF of parking brake switch LS_{PB}
ESY-29		ON/OFF of lift switch LS_L
ESY-30		ON/OFF of tilt switch LS_T
ESY-31		ON/OFF of seat limit switch LS_D
ESY-32		ON/OFF of attachment switch LS_{ATT}
ESY-33		ON/OFF of attachment switch LS_{ATT2}
ESY-34		ON/OFF of attachment switch LS_{ATT3}

Test No.: ESY-01

All diagnostic items other them those shown below are detected.
The error code and description are displayed on the screen.
Error codes display, but error description are not displayed: A3 • AE • AF • CE • CF • EE • EF
Error codes not displayed: F0·F1 ~ F8

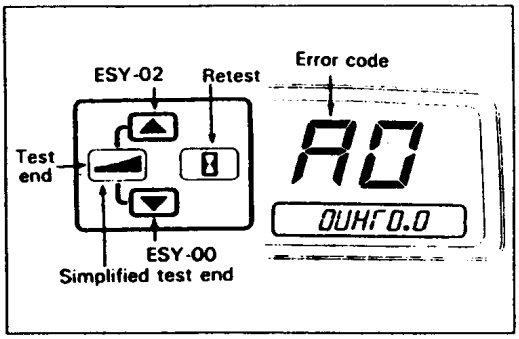
1. If the check result is normal, 00 is displayed on the speedometer.

2. If abnormal, the corresponding error code is displayed with buzzer sounding.

3. If multiple errors occur, they are displayed sequentially.

   Action: Investigate the error position by referring to the troubleshooting.

   Note:
   See page 5-28 for the list of display by the hour meter.



Test No.: ESY-02 to 11

Past diagnosis errors are displayed.

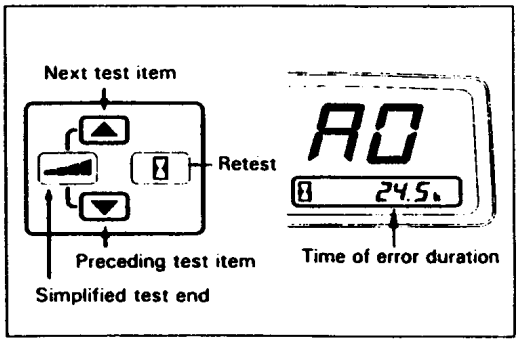
ESY-02: Most recent error
ESY-11: 10th error from the most recent one

1. Select the function by pressing the switch.

   (1) ESY-XX is displayed with blinking three times on the hour meter.

   (2) The error occurrence time and error code are displayed on the hour meter and speedometer, respectively.

   Action: Investigate the error position by referring to the troubleshooting.



Test No.: ESY-12 to 14

The voltage at the voltage input terminal is measured and displayed.

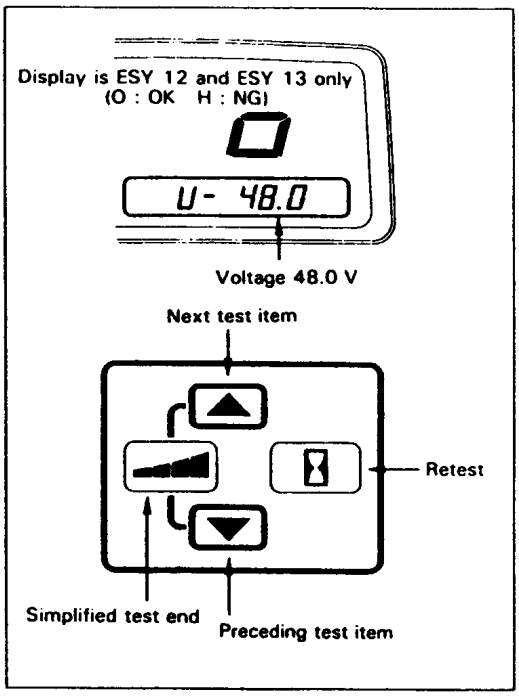
ESY-12: Voltage at battery terminal: VBBT (Displayed up to 65 V.)
ESY-13: Voltage at key switch terminal: VBKY (Displayed up to 52 V.)
ESY-14: / (Not detectable because of MB contactor adoption)

1. Select the function by pressing the switch.
   (1) ESY-XX is displayed with blinking three times on the hour meter.
   (2) The voltage is displayed on the hour meter.
   (3) Measure the input voltage at each terminal with a multi-meter, and check the difference from the displayed valve.
   Standard (See page 4-11)
   VBBT/VBKY: Within ±1%
   (4) When the displayed voltage is 52 V or less, check the difference between VBBT and VBKY.

   Action: ① Abnormality of trimmer potentiometer in CPU → Replace the CPU board.

   Caution:
   Never tamper with the trimmer potentiometer.

   ② When the voltage is 0 V, check the harness.



Test No.: ESY-15 to 17

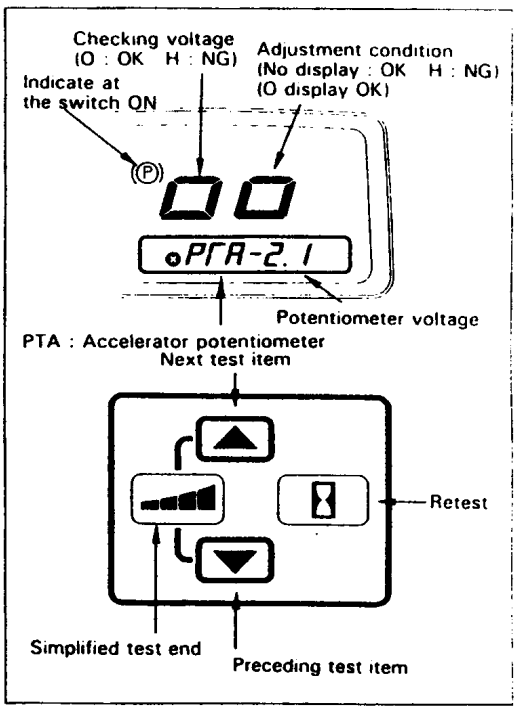
The potentiometer voltage with satisfaction or dissatisfaction of the specified range and the properness of the corresponding switch ON/OFF state are displayed.

ESY-15: Accelerator potentiometer (SW_{AC}, VRA)
ESY-16: Brake limit switch (LS_B)
ESY-17: Lift potentiometer (LS_L, VRAP)

1. Press the switch to select the function.
   (1) ESY-xx is displayed with blinking 3 times on the hour meter.
   (2) The potentiometer type and potentiometer voltage are displayed on the hour meter.
   (3) The speedometer displays whether the potentiometer voltage is within the specified range and whether the switch on/off state is proper.

   Accelerator potentiometer voltage check
   ① Operate the accelerator pedal (switch) and read the voltage (A) when the "P" mark is displayed (switch ON).
   ② Operate the accelerator pedal further and read the voltage (B) at the pedal stroke end.
   ③ Calculate B - A = C.
   ④ C: 1.4 V or more

   Actions: ① Check the potentiometer installation state. (See pages 4-32 and 4-33.)
   ② Check the harness.
   ③ Replace the potentiometer.
   ④ Replace the CPU board.



- "O" or "H" for voltage check is displayed only when adjustment is OK. If adjustment is NG, nothing is displayed for voltage check.
- No display is made if the adjustment state is OK, and "H" is displayed if adjustment is NG.
  When "H" is displayed, make adjustment while "H" is displayed.
  If the adjusted level comes within the standard range, display changes from "H" to "0".
- For the brake switch only check the Ⓟ indication (ON/OFF). The potentiometer voltage on the display is fixed at 0.0 V.

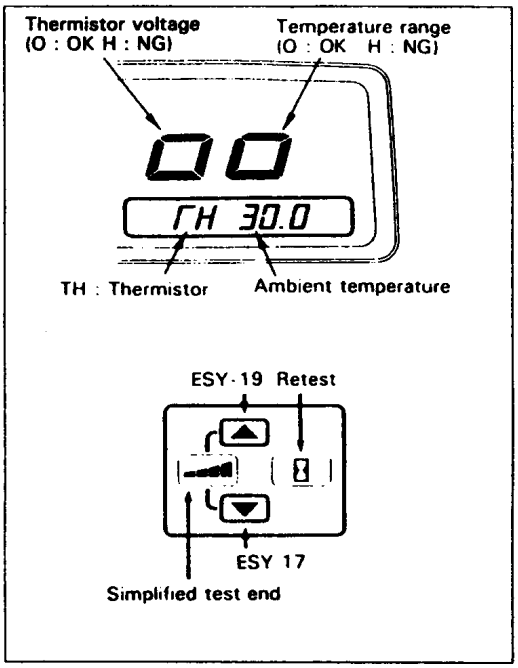
Test No.: ESY-18

Temperature sensor check

The temperature detected by the thermistor on the CPU board is displayed. The properness of the temperature and voltage range is checked and displayed.

1. Press the switch to select the function.
   (1) ESY-18 is displayed with blinking 3 times on the hour meter.
   (2) The temperature on the CPU board is displayed on the hour meter.
   (3) The speedometer displays whether the temperature range is normal and whether the thermistor voltage is normal.

   Actions: ① Check the ambient temperature of the CPU board by comparison with the data measured by the thermometer.
   ② Replace the CPU board.



Test No.: ESY-19 to 22

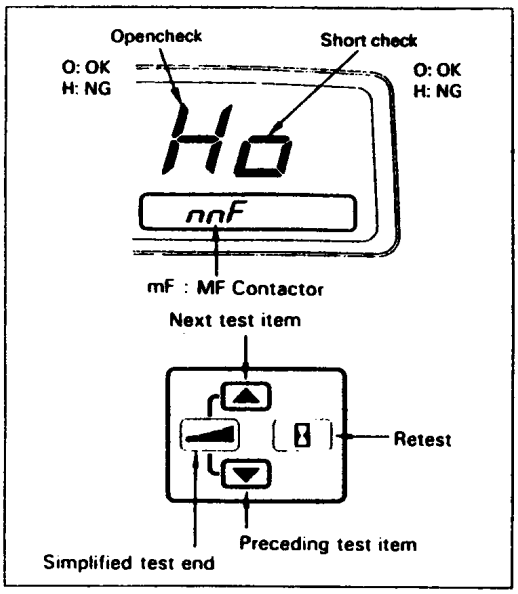
Contactor closing test

ESY-19: Forward contactor (MF) test
ESY-20: Reverse contactor (MR) test
ESY-21: Regenerative contactor (MG) test
ESY-22: Power supply contactor (MB) test

The MG contactor operation can be checked by ESY-21, but the drive circuit check result (open-short) is not displayed.

1. Press the switch to select the function.
   (1) ESY-xx is displayed with blinking three times on the hour meter.
   (2) The contactor code is displayed on the hour meter.
   (3) Visually check closing or opening of each contactor.

   Actions: ① Check welding of the contactor.
   ② Check the resistance of the contactor coil. (See page 4-23.)
   Check the voltage at the time of contactor closing.
   (The contactor is defective if it is 30 V or more.)
   ③ Replace the DC-CD board.
   ④ Replace the CPU board.



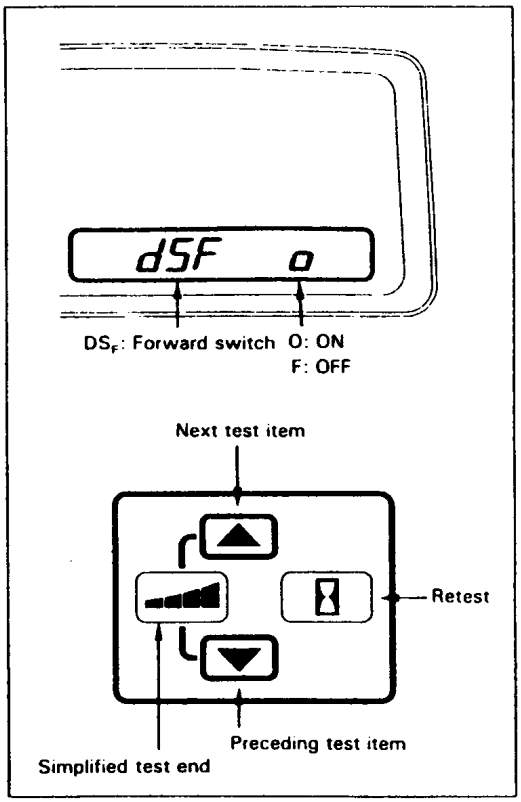
Test No.: ESY-23 to 34

Switch ON/OFF and buzzer check

ESY-23: Forward direction switch (DS_F)
ESY-24: Reverse direction switch (DS_R)
ESY-25: Accelerator switch (SW_{AC})
ESY-26: Brake switch (SW_B)
ESY-27: Speed control switch (SW_{SC})
ESY-28: Parking brake limit switch (LS_{PB})
ESY-29: Lift limit switch (LS_L)
ESY-30: Tilt limit switch (LS_T)
ESY-31: Seat limit switch (LS_D)
ESY-32: Attachment limit switch (LS_{ATT}) (unused)
ESY-33: Attachment limit switch 2 (LS_{ATT2})
ESY-34: Attachment limit switch 3 (LS_{ATT3}) (unused)

1. Press the switch to select the function.
   (1) ESY-XX is indicated with blinking three times on the hour meter display.
   (2) The switch code is indicated on the hour meter display.
   (3) When the selected switch is set to ON, F on the hour meter display is changed 0 and the buzzer sounds.

   Actions: ① **Check the switch**
   ② **Check the switch harness.**
   ③ **Check the CPU board. (See pages 4-9 to 4-14.)**
   ④ **Replace the CPU board.**



Category 1	Class 2	Test operation (voltage, current or temperature display)

In the test operation, traveling and/or material handling are possible while monitoring the analog input value of each sensor.

If a diagnosis error occurs during traveling and/or material handling, the error code is displayed to enable very infrequent troubles to be confirmed.

Analog input items to be monitored

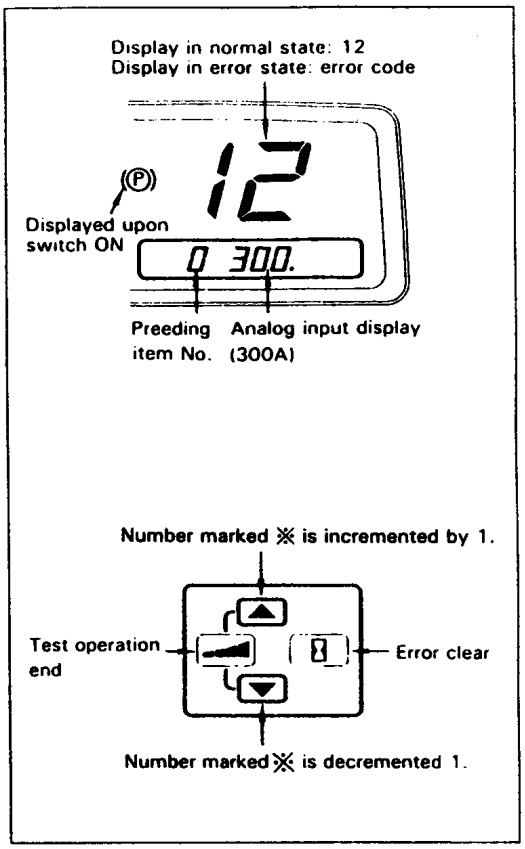
No.	Item		Description
0	Drive motor current	A	Abnormality of current sensor or current detecting circuit, deviation of OCL value or abnormal forklift load
1	Pump motor current	A	Abnormality of current sensor or current detecting circuit or abnormal forklift load
2	Battery terminal voltage	V	Abnormality of voltage detecting circuit (excessive charge indicator display error)
3	Key switch terminal voltage	V	Abnormality of voltage detecting circuit (excessive charge indicator display error)
4	P2 terminal voltage	V	Abnormality of voltage detecting circuit (contactor opening or incorrect detection of A1 error)
5	Accelerator potentiometer voltage	V	Abnormality of acceleration sensor, or abnormality in acceleration potentiometer detecting circuit (maximum speed)
6	Brake switch ON/OFF state	V	Abnormality of brake switch or brake switch circuit
7	Lift potentiometer voltage	V	Abnormality of lift potentiometer, or abnormality in lift potentiometer detecting circuit (lifting speed)
8	Atmospheric temperature	°C	Abnormality of thermo sensor or abnormality in thermo sensor detecting circuit.
9	Controller thermo sensor voltage	V	Abnormality of thermo sensor or abnormality in thermo sensor detecting circuit

The analog input value is displayed in the test operation.

The error code is displayed when an error occurs and is retained until the error clear switch is pressed.

1. Press the switch to select the function.
   (1) The test No. is displayed on the hour meter.
   (2) The current value, etc. during the test operation are displayed on the hour meter.
   (3) 12 (Category 1, class 2) is displayed on the speedometer in normal state.
   (4) If an error occurs, the error code is displayed on the speedometer and is retained until the error clear switch is pressed.

   Action: Investigate the error position and the part showing an abnormal value by referring to the troubleshooting procedure.



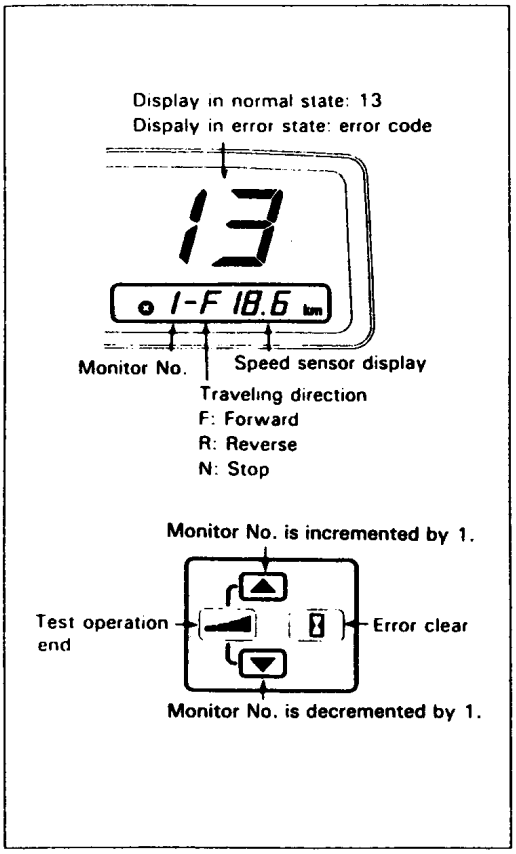
Category 1	Class 3	Test operation (traveling speed display)

Traveling while monitoring the traveling speed value input from the speed sensor is possible during the test operation.
If a diagnosis error occurs during traveling and/or material handling, the error code is displayed to enable very infrequent troubles to be confirmed.

No.	Item	Description
1	Traveling direction and detected speed value	Check if the drive wheel revolving direction and traveling speed are deviated from the displayed values.
2	Traveling direction and speed sensor No. 1 data	If abnormality in traveling speed detection is found in test No.1, check if the data from speed sensors No.1 and No.2 agree with the actual traveling speed.
3	Traveling direction and speed sensor No. 2 data	

1. Press the switch to select the function.
   (1) The test No. is displayed on the hour meter.
   (2) The traveling direction is displayed on the hour meter.
   (3) The traveling speed or speed sensor input data is displayed on the hour meter.
   (4) When an error occurs, the error code is displayed on the speedometer and is retained until the error clear switch is pressed.

   Action: Investigate the error position and the part showing an abnormal value by referring to the troubleshooting procedure.



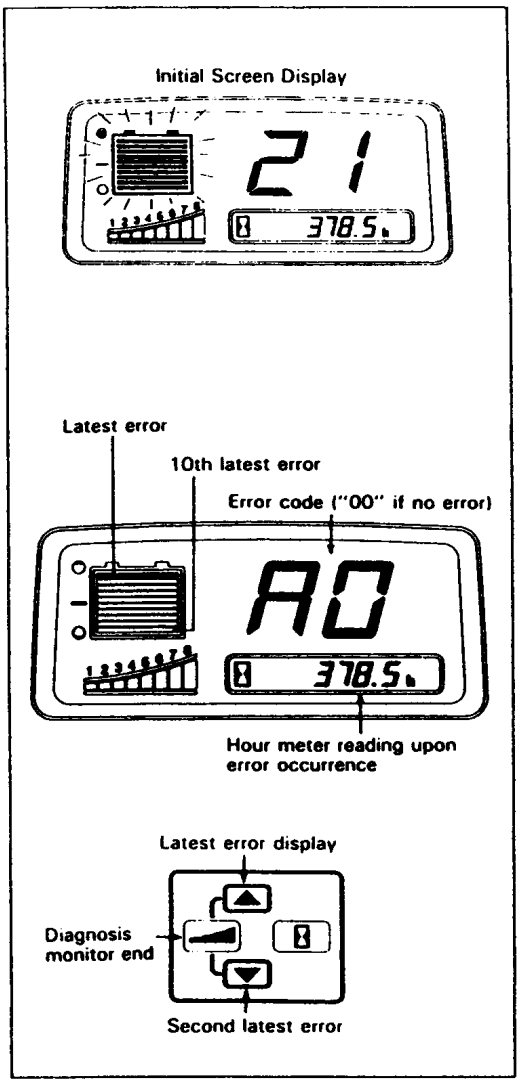
Category 2	Class 1	Diagnosis monitor

Past errors (10 items in total) are displayed with the corresponding hour meter readings.

Use this test when the user found an error during operation but failed in regeneration.

1. Press the switch to select the function
   (1) The serial number of error occurrence is displayed on the battery charge indicator.
   (2) The time of error occurrence is displayed on the hour meter.
   (3) The error code is displayed on the speedometer.

   Action: Investigate the error position by referring to the troubleshooting procedure.

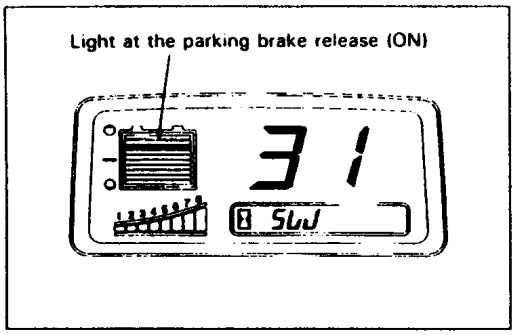


Category 3	Class 1	Switch input test: ON/OFF information display

The ON/OFF state of every switch is displayed to allow confirmation at a glance.

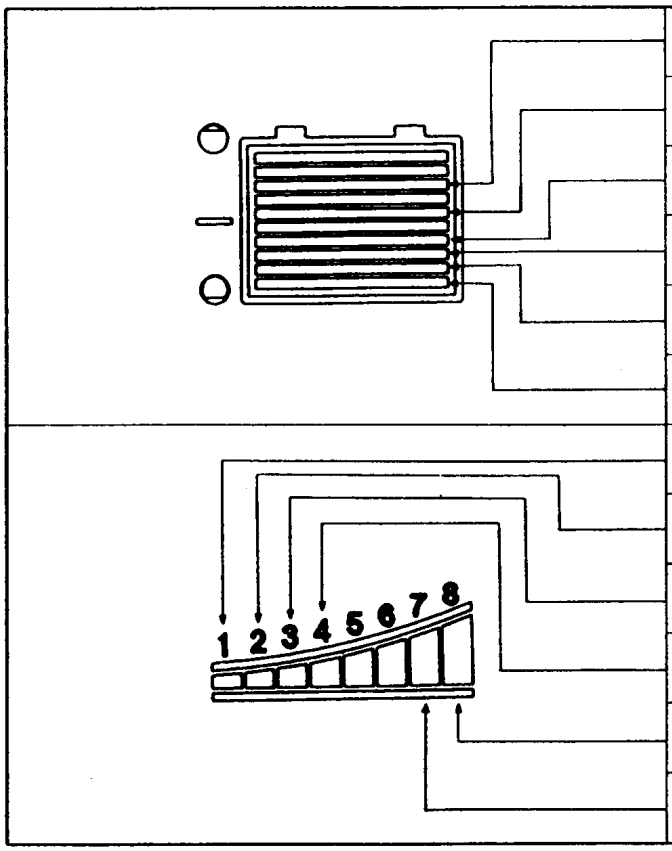
A level line in the battery charge indicator or a level line in the power control level gauge corresponds to each switch.

The corresponding position comes on when each switch is ON.



Initial Screen Display BARS201

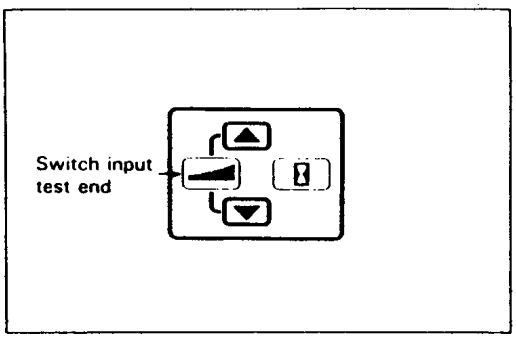
Display and switch table



Parking brake limit switch	(LS_{PB})
Speed control switch	(SW_{SC})
Brake switch	(SW_{B})
Accelerator switch	(SW_{AC})
Reverse direction switch	(DSR)
Forward direction switch	(DSF)
Lift limit switch	(LS_{L})
Tilt limit switch	(LS_{T})
Attachment limit switch	(LS_{ATT})
Attachment limit switch 2	(LS_{ATT2})
Attachment limit switch 3	(LS_{ATT3})
Seat switch	(LS_{D})

1. The corresponding part is lit, when each switch is set to ON.

   Action: If the switch ON/OFF state differs from the display, check and repair the switch, harness or CPU board.



Category 3	Class 2	Switch input test: Buzzer check

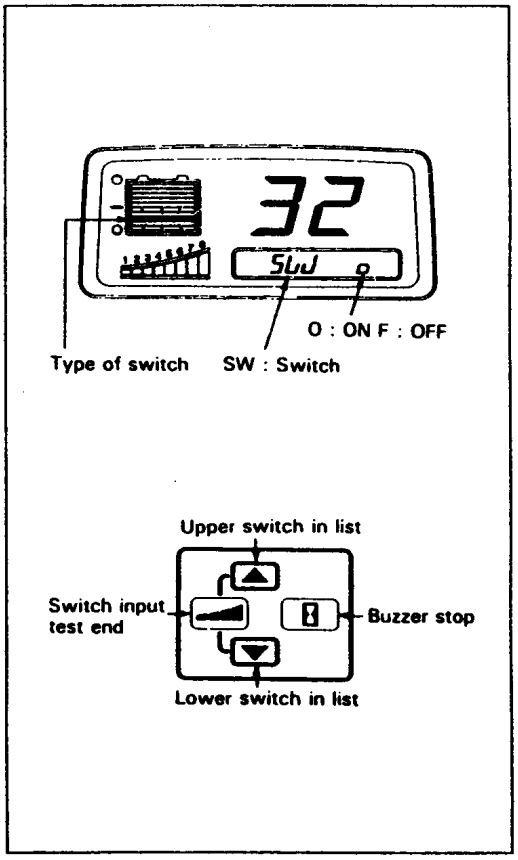
The ON/OFF state of each switch is informed by the buzzer.

Uses.
(1) Turning of limit switch or potentiometer
(2) Switch ON/OFF check in a place where the display is invisible

1. Press the switch to select the switch to be tested.
   (1) See page 5-25 "Display and Switch Table" for the types of switches.

2. Operate the switch and check if the buzzer sounds.

   Action: If the switch ON/OFF state differs from the buzzer indication, check and repair the switch, harness or CPU board.

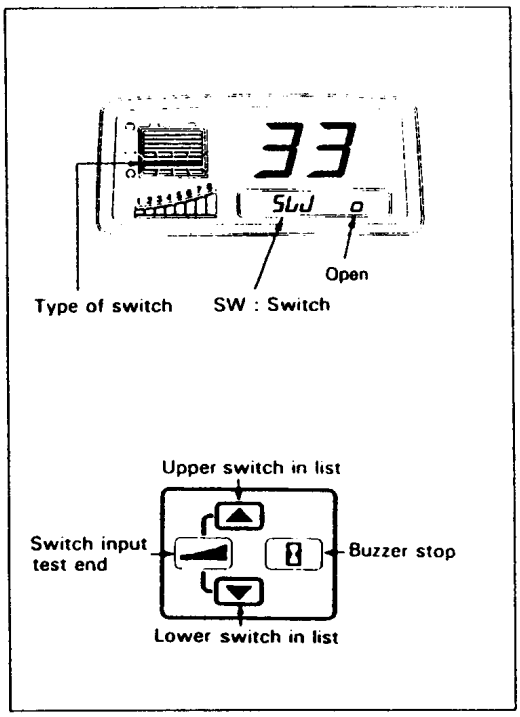


Category 3	Class 3	Switch input test: Momentary interruption test

Memory interruption (open-circuit) in the switch input line is checked.

1. Set the switch to be checked to ON.
2. Press a display switch to match the display with the desired switch to be checked.
   (1) See page 5-25 "Display and Switch Table" for the switch types.
   (2) When the buzzer is sounding, stop it by pressing the stop switch.
3. Shake or apply vibration to the wiring to be checked.
   (1) The buzzer sounds if momentary interruption (open-circuit) occurs.

   Action: Repair the switch or harness.

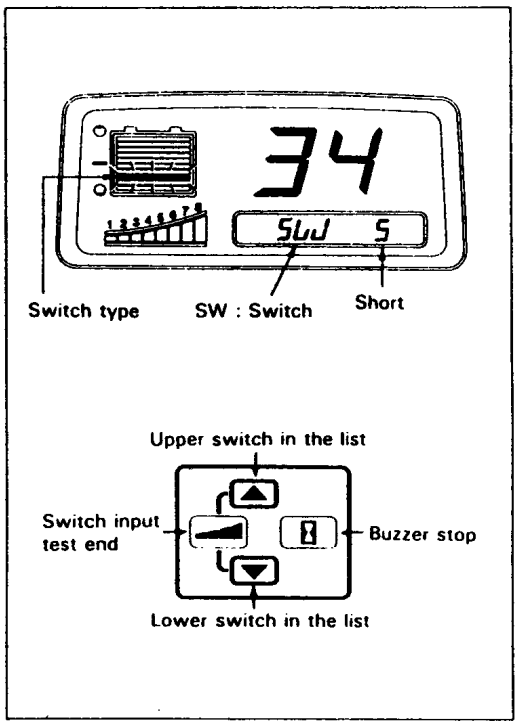


Category 3	Class 4	Switch input test: Short-circuit test

Short-circuit in the switch input line is checked.

1. Set the switch to be checked to OFF.
2. Press the switch to match the display with the desired switch to be checked.
   (1) See page 5-25 "Display and Switch Table" for the switch types.
   (2) When the buzzer is sounding, stop it by pressing the stop switch.
3. Shake or apply vibration to the wiring to be checked.
   (1) The buzzer sounds if short-circuit occurs.

   Action: Repair the switch or harness.



ESY-01 On hour meter display:

Error code	Error description	Hour meter display	Hour meter display reading and explanation
A0	Overheat	oUHr0.0	OVHT 0.0 Controller temperature sensor voltage
A1	Overvoltage	oUU 0.	OVV 0. P2 terminal•VBP2 voltage
A2	Abnormal temperature rise	r 0.0	T 0.0 Controller ambient temperature
A4	Accelerator potentiometer abnormality	SEr d0.0	SETD 0.0 Traveling accelerator potentiometer voltage
A5	Brake switch abnormality	SEr b0.0	SETB 0.0 Brake switch voltage
A6	Lift switch abnormality	SEr L0.0	SETL 0.0 Lift switch potentiometer voltage
A8	F1 fuse open	FUSEd	FUSED F1 fuse open
A9	F2 fuse open	FUSEP	FUSEP F2 fuse open
AA	Temperature sensor abnormality	rHA 0.0	THA 0.0 Temperature sensor voltage
C0	TMD or SD abnormality	Udd	VDD TM abnormality
C1	Traveling current sensor abnormality	CSd 0.0	CSD 0.0 CSD abnormality
C3	Controller temperature sensor abnormality	rHC 0.0	THC 0.0 Controller temperature sensor voltage
C4	Traveling accelerator potentiometer abnormality	Por d0.0	POTD 0.0 Traveling accelerator potentiometer voltage
C7	Direction switch abnormality	SU	SU Direction switch abnormality
C8	Speed sensor abnormality	roEr En	ROTEN Speed sensor abnormality
C9	MG contactor abnormality	nnG	MG MG contactor abnormality
CA	MF•MR contactor abnormality	nnFr	M FR MF•MR contactor abnormality
CC	CPU board Traveling OCL circuit abnormality	oCLd	OCLD Traveling OCL circuit abnormality
E0	TMP or SD abnormality	UdP	VDP TMP abnormality
E1	Material handling current sensor abnormality	CSP 0.0	CSP 0.0 CSP voltage
E6	Material handling accelerator abnormality	Por L0.0	POTL 0.0 Material handling potentiometer voltage
EA	MB contactor abnormality	nnb	MB MB contactor abnormality
EC	CPU board Material handling OCL circuit abnormality	oCLP	OCLP Material handling OCL circuit abnormality

MCS-II TUNING

GENERAL

When a user requests "maximum speed limiting" or "weakening of regenerative braking force", turning is possible in the similar way as power control adjustment.
Record the items to be tuned and their set level that will be required for resetting after replacing the display board

MCS-II Tuning mode initial level setting list

Tuning code	Item	Level (● Initial setting level)							
		1	2	3	4	5	6	7	8
C1	Regenerative braking torque: Varying the regenerative braking torque in switchback operation	Weak			●				Strong
C2	Material handling chopper soft start: Varying the degree of rise of the material handling chopper duty	Small				●			Large
C3	Material handling chopper starting duty: Varying the initial duty in soft start of the material handling chopper	Small		●					Large
C4	Battery charge meter correction: Correcting the decreasing rate of battery charge meter indication	Slow					●		Quick
C5 (See page 5-30)	Maximum traveling speed limiter: Limiting the maximum traveling speed	Low speed							No limit ●
C6	Attachment power control 1: Varying the pump motor revolving speed when attachment switch 1 is ON	Low							High ●
*1 C7	Attachment power control 2: Varying the pump motor revolving speed when attachment switch 2 is ON	Low							High ●
C8	Lifting power control: Varying the pump motor revolving speed during lifting	Low							High ●
C9	Tilting power control: Varying the pump motor revolving speed	Low					●		High
CA (See page 5-31)	Lift interrupt set level: Varying the operation timing (discharge level) for overdischarge alarm function	Early						100% ●	No alarm
CC ~ CF	Unused								

*1: This is provided as a reserve for a special model because a different main harness is required.

USING MCS-II TUNING

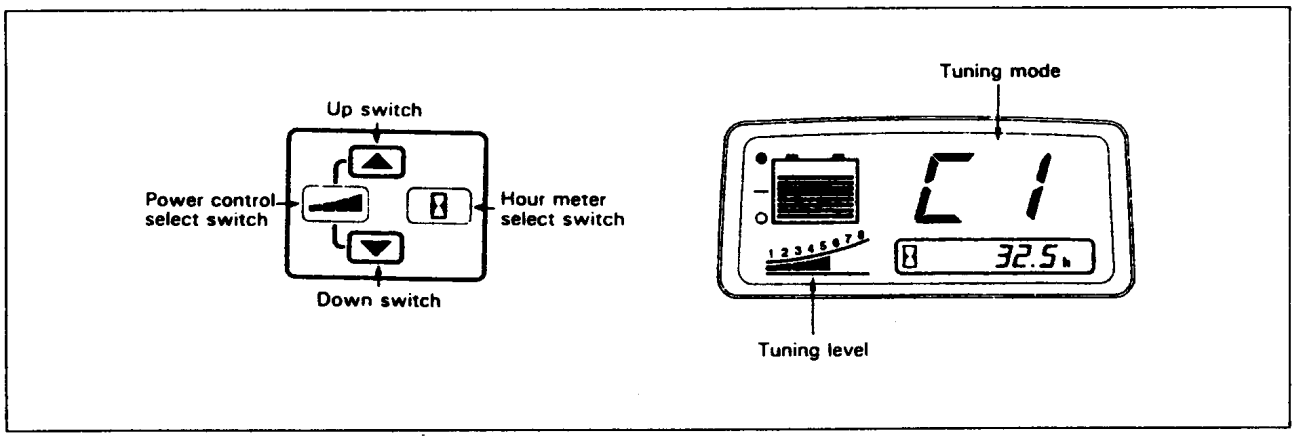
1. Input from the primary to the secondary passeword according to the password list on page 5-6.

2. Press the power control switch.
   (1) The tuning mode is displayed on the speedometer.
   (2) The current tuning level is displayed on the power control level gauge.

3. Set to the desired tuning mode.
   The tuning mode is changed sequentially each time the power control select switch is pressed.
   (C1 → C2 → ··· CF → C1)

4. Set the tuning level.
   To increase the tuning level: Press the up switch.
   To decrease the tuning level: Press the down switch.

5. If any more item is desired to be tuned, repeat steps 3 and 4.
   Return from the tuning mode to the standard display (speedometer display) by any of the three following methods:
   (1) Press the hour meter select switch.
   (2) Turn the key switch to OFF once and turn it to ON again.
   (3) Wait without any operation. (The standard display starts automatically 2 minutes later.)



Maximum speed limiter (tuning code: C5)

The maximum speed can be limited to any of the eight stages shown in the table below.

Set level to maximum speed Unit: km/h (mph)

Set level	1	2	3	4	5	6	7	8
Maximum speed	6 ± 1 (3.8 ± 0.6)	7 ± 1 (4.4 ± 0.6)	8 ± 1 (5.0 ± 0.6)	9 ± 1 (5.6 ± 0.6)	10 ± 1 (6.2 ± 0.6)	11 ± 1 (6.8 ± 0.6)	12 ± 1 (7.4 ± 0.6)	No limit

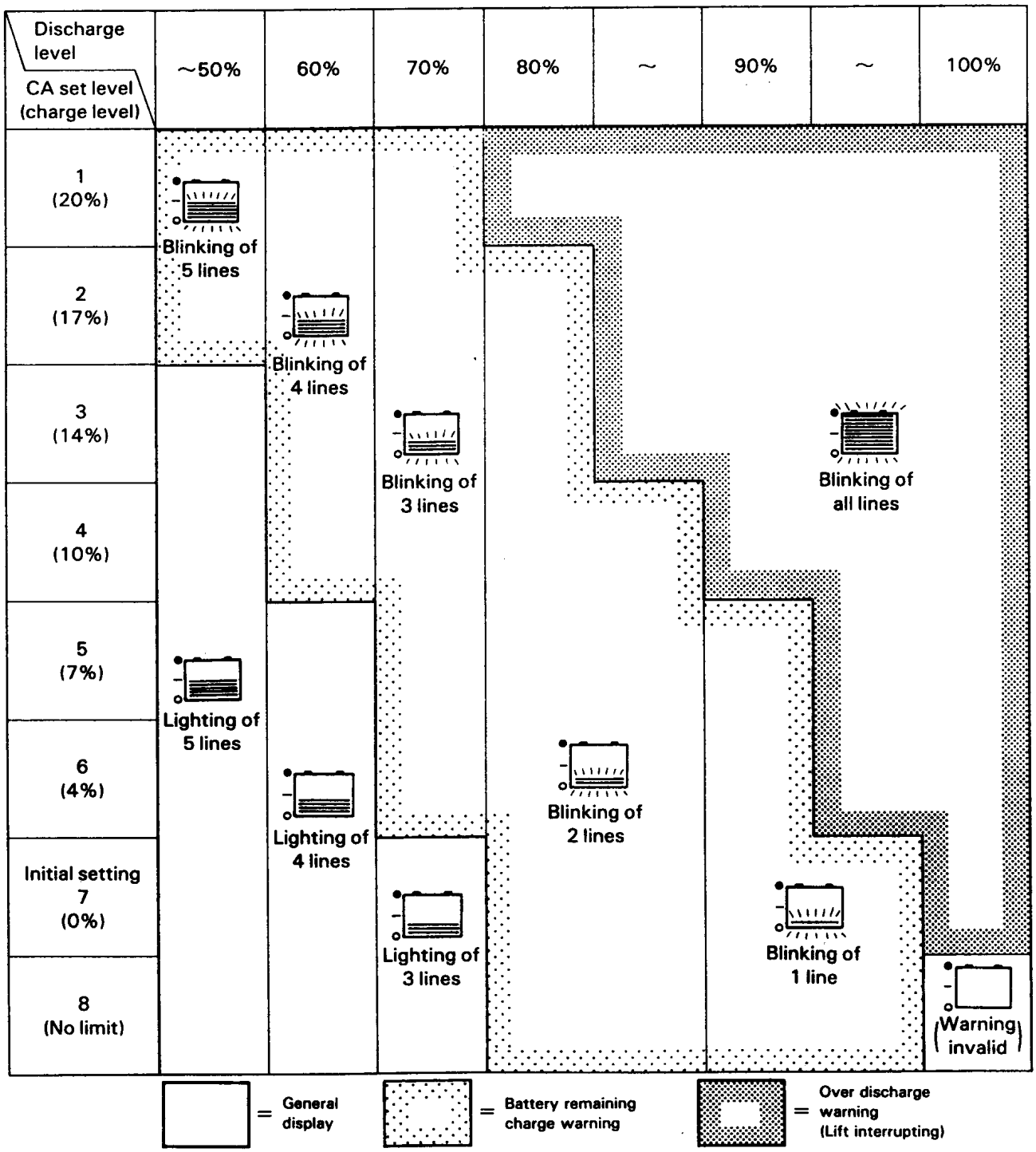
Lift interrupt function (tuning code: CA)

This function protects the battery from overdischarge by disabling material handling operation at the same time with overdischarge warning on the multi-display.

Note:
Simultaneous traveling and material handling are enabled once for 30 seconds when the key switch is turned from OFF to ON.

Set level to discharge level

Example:
When the CA set level is 5, low battery warning is activated at 70% discharge (charge level: 30%) and overdischarge warning is activated at 93% discharge (charge level: 7%).



TIRE CONSTANT REWRITING

GENERAL

The speedometer operation is affected by the tire type (tire diameter). The speedometer display is set to match the tires installed on the vehicle at the time of shipment.

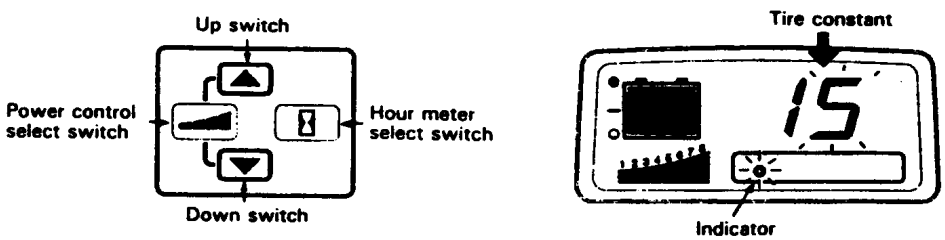
USING TIRE CONSTANT REWRITING

1. Input to the secondary password according to the password list on page 5-6.
   Display
   (a) The current tire constant (2 digits) is displayed on the speedometer.
   (b) The tire mark is displayed on the hour meter.

2. Check the tire constant by referring to the tire size and constant table, and adjust the tire constant displayed on the speedometer accordingly.
   (a) The blinking digit of the tire constant alternates between 10's place and 1's place each time the power control select switch is pressed.
   (b) Press the level setting switch (up or down switch) to vary the figure in the blinking digit.

Model	Pneumatic cushion tire		Pneumatic tire	
	Tire size	Tire constant	Tire size	Tire constant
FBMF16	21×8-9 6.50-10 (O/S)	41 52	21×8-9-14PR 6.50-10-12PR (O/S)	37 53
FBMF20·25	23×9-10	57	23×9-10-18PR	53
FBMF30	28×9-15	89	28×9-15-14PR	86

3. Return from the tire constant rewriting mode to the standard display (speedometer display) by any of the three following methods:
   (a) Press the hour meter select switch.
   (b) Turn the key switch to OFF once and to ON again.
   (c) Wait without any operation. (Standard display starts automatically 2 minutes later.)



POWER CONTROL INPUT

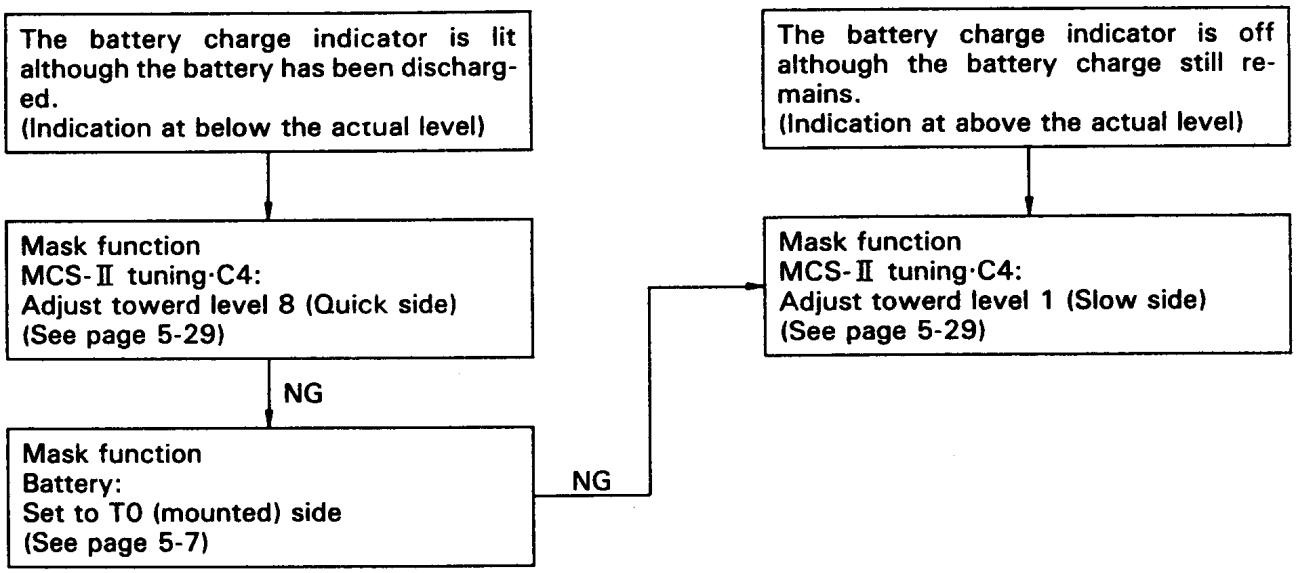
The power control input can be locked or unlocked by password input. If P1 is indicated on the speed display portion upon password input, the power control input is set to the locked state. If P0 is displayed, the power control input is unlocked.

BATTERY

This data is provided for changing over the constant for calculation for the battery charge indicator. It is possible to select battery mounted state or not mounted state by password input. The speedometer on the display indicates T1 when the not mounted state is selected, and T0 when the mounted state is set.

Note:
When the battery discharge is more than the indicated level, set to T0 (mounted). In the opposite case, set to T1 (not mounted).

Battery charge indicator correction procedure



ELECTRICAL SYSTEM TROUBLESHOOTING

GENERAL

This troubleshooting section is provided for checking the causes of diagnostic errors indicated by corresponding error codes on the display and other electrical troubles for immediate repairs.

A circuit tester, megger and other measuring instruments are used for checking errors. Some items can be checked by using the analyzer on the vehicle.

This manual is edited on assumption of mechanics who have mastered handling of measuring instruments, are capable of reading wiring and connection diagrams correctly, and can perform accurate measurement according to connector diagrams.

Use the appended wiring, connection and connector diagrams.

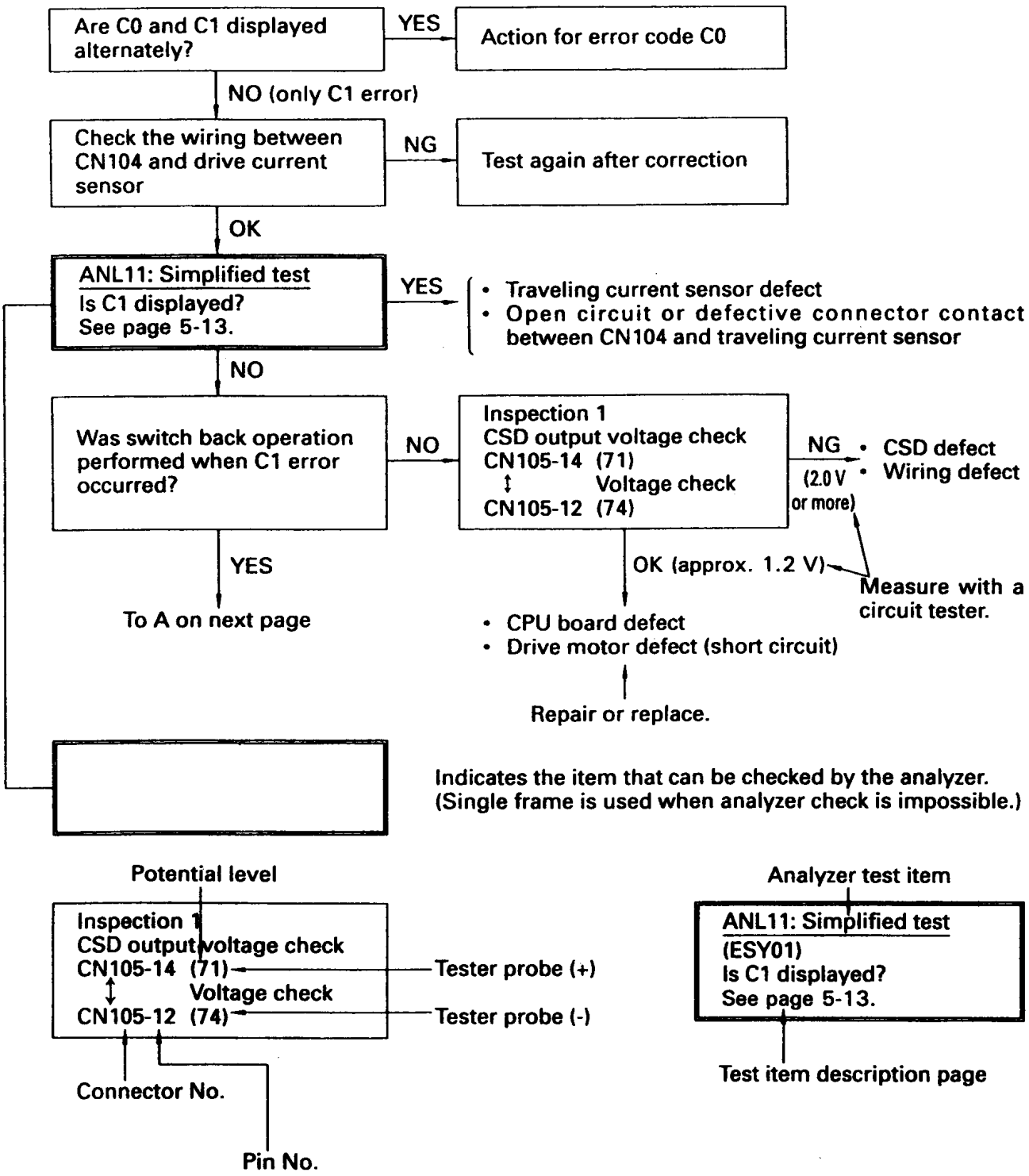
TROUBLESHOOTING EXPLANATION

1. When the diagnostic error code is displayed
   See the corresponding section from page 6-4.

2. When the diagnostic error code is not displayed
   See the corresponding section from page 6-63.

   (1) Drive system troubles
   See the corresponding section from page 6-63.
   (2) Material handling system troubles
   See the corresponding section from page 6-88.
   (3) Steering system troubles
   See the corresponding section from page 6-90.
   (4) Display troubles
   See the corresponding section from page 6-94.

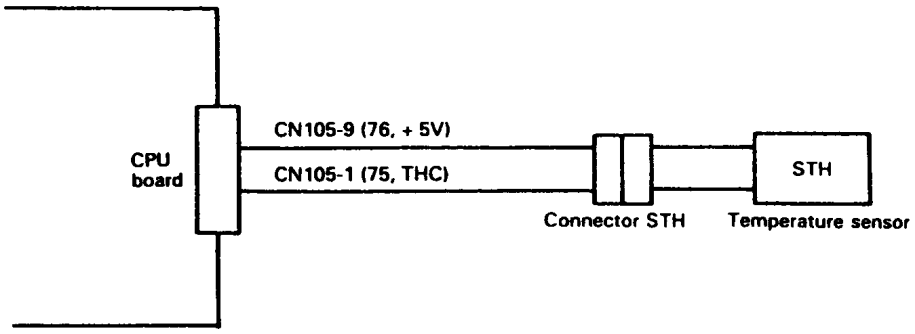
3. TROUBLESHOOTING EXPLANATION



DIAGNOSTIC ERROR CODE IS DISPLAYED

ERROR CODE A0: MCS MAIN CIRCUIT OVERHEAT

Related portion



Estimated causes

① Overheat (continued use with overload)

② Temperature sensor defect

③ Temperature sensor wiring and connector contact defect

④ CPU board defect

Continued use of vehicle with overload? — YES → Stop the vehicle and restart traveling 30 minutes later.

NO

Inspection 1
Disconnect connector STH and check the resistance of temperature sensor.

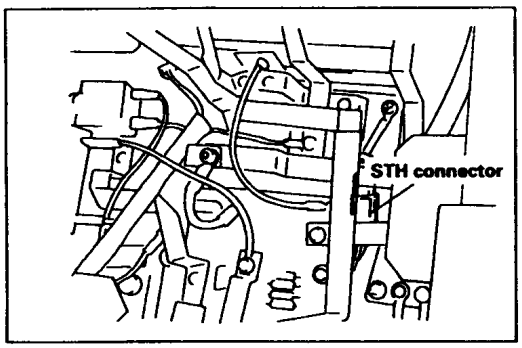
NG (2 kΩ or more) → Temperature sensor defect

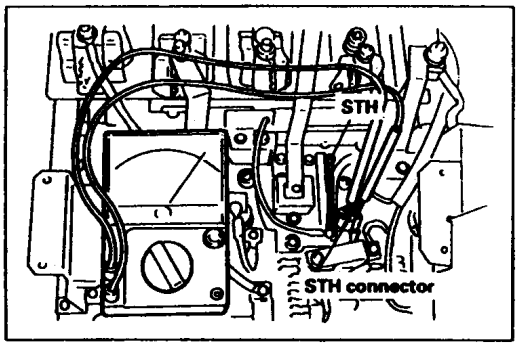
OK (less than 2 kΩ)

- Defective contact between CN105 and connector STH
- CPU board defect

Inspection 1 Temperature sensor resistance check
Battery plug OFF, connector STH disconnection

Measurement terminals	Both terminals of connector STH (sensor side)
Circuit tester range	Ω x 1
Standard	Less than 2 kΩ

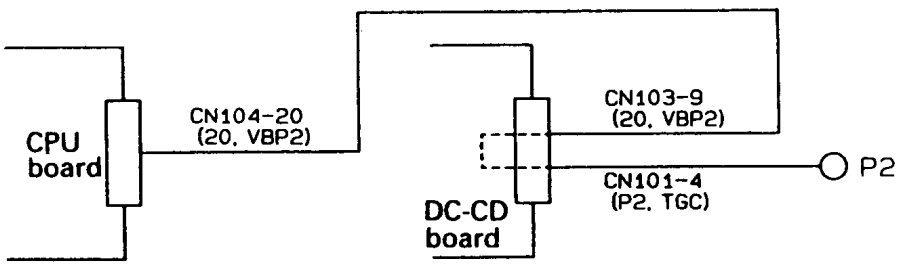




OK (less than 2 kΩ) → CPU board defect, defective contact between CN105 and connector STH
NG (2 kΩ or more) → Temperature sensor defect

ERROR CODE A1: MCS MAIN CIRCUIT OVERVOLTAGE

Related portion



Estimated causes

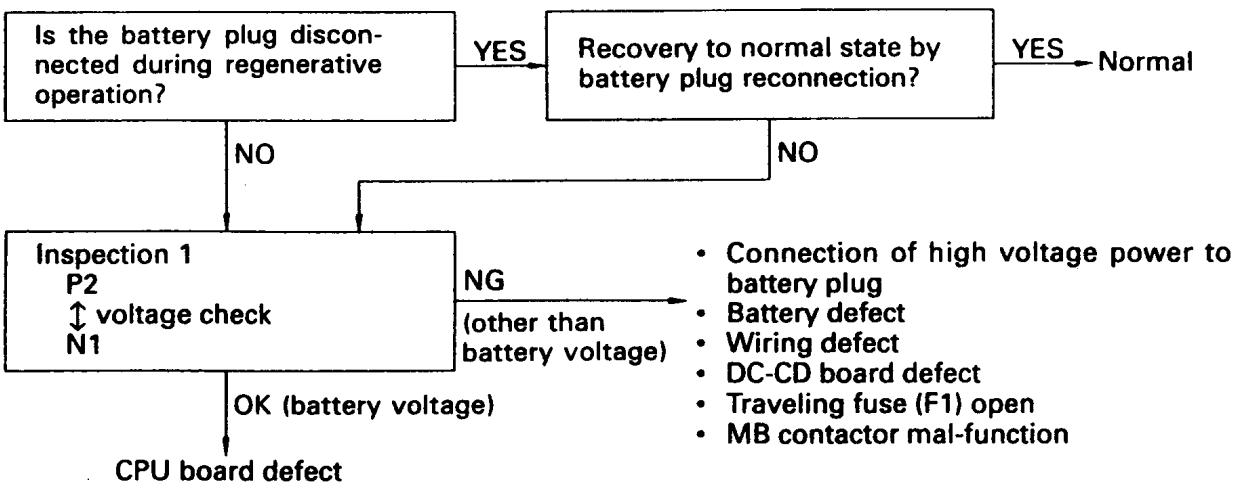
① Battery plug disconnection during regenerative operation

② CPU board defect

③ Connection of other than specified battery voltage to battery plug

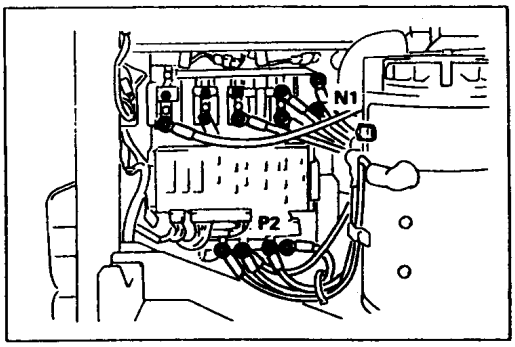
④ Traveling fuse (F1) open

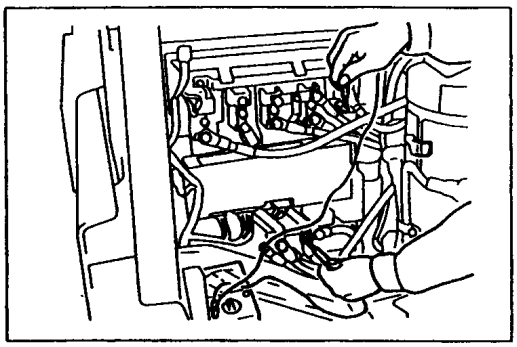
⑤ MB contactor mal-function



Inspection 1. P2 – N1 voltage check
Battery plug ON, SW_{KV} ON

Measurement terminals	P2 ⊕ – N1 ⊖
Circuit tester range	DC 250V
Standard	Battery voltage

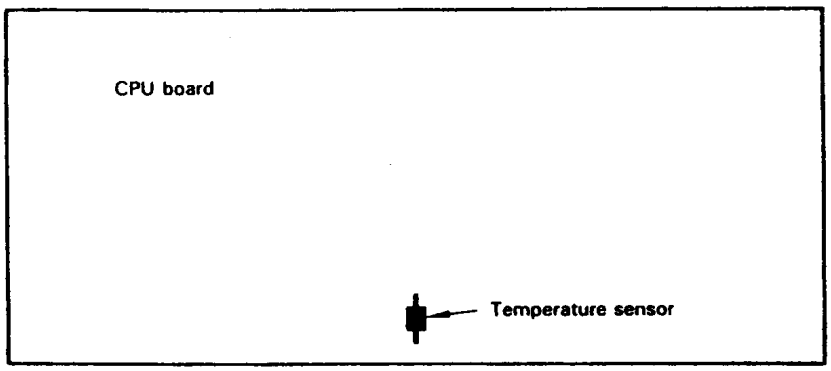




OK (battery voltage) → CPU board defect
NG (other than battery voltage) → Battery defect, wiring defect, DC-CD board defect, traveling fuse (F1) open, MB contactor mal-function, connection of high voltage power to battery plug

ERROR CODE A2: CPU BOARD ABNORMAL TEMPERATURE RISE

Related portion

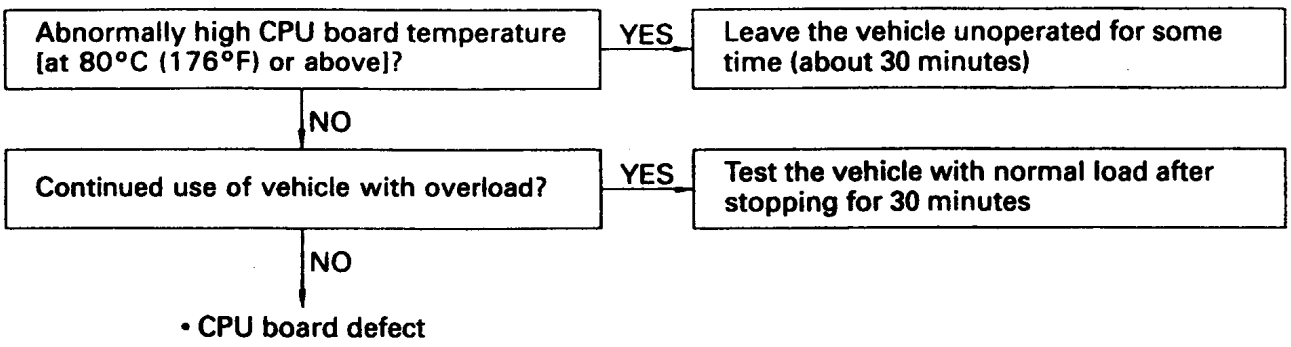


Estimated causes

① CPU board temperature at 80°C (176°F) or above

② Overheat (continued use with overload)

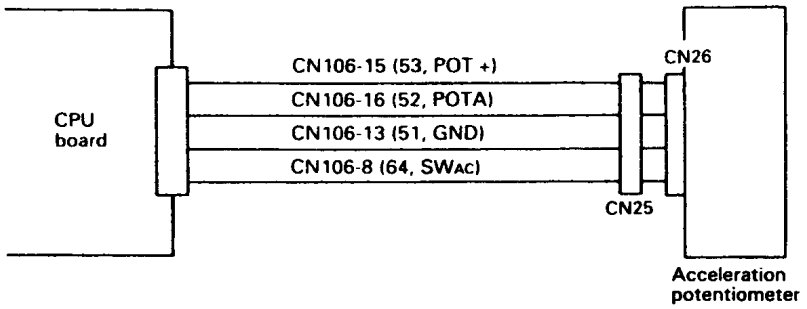
③ Temperature sensor defect (CPU board defect)



*** The CPU temperature sensor is included on the CPU board. CPU board defect is conceivable when this error code (A2) is displayed.**

ERROR CODE A4: ACCELERATION POTENTIOMETER INSTALLATION DEFECT

Related portion



Estimated causes

① Acceleration potentiometer defect (between 64 and 51)
② Acceleration potentiometer installation adjustment defect
③ Acceleration switch wiring short circuit (between 64 and 51)
④ CPU board defect

Is the battery plug connected while the accelerator pedal is depressed?
YES → Is the normal state recovered when the accelerator pedal is released?
YES → Normal
NO
NO

ANL31: Switch input test
Is the accelerator switch ON or OFF when the accelerator pedal is not depressed?
See page 5-25.

Not lit (switch OFF) → Is "A4" displayed when vibration is applied to the vehicle during traveling?
NO → CPU board defect

Lit (switch ON)

- Carry out ANL31: again after disconnecting the acceleration potentiometer connector.

YES

- P1-N1 wiring contact defect
- P2 wiring contact defect
  (see the "Related portion" in A1 error explanation.)

ANL31: Switch input test
Is the accelerator switch ON or OFF when the accelerator pedal is not depressed?
See page 5-25.

Lit (switch ON) → Accelerator switch wiring short circuit (short circuit between 64 and 51)

Not lit (switch OFF)

Inspection 1
Individual acceleration potentiometer inspection

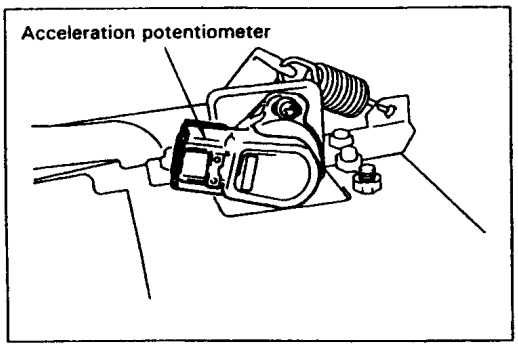
NG (always 0 Ω) → Acceleration potentiometer defect

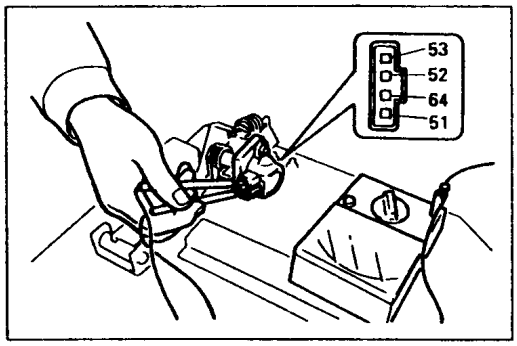
OK (ordinary state: ∞ Ω, operated state: 0 Ω)

Installation adjustment defect

Inspection 1. Individual acceleration potentiometer measurement
Individual acceleration potentiometer removal

Measurement terminals	Acceleration potentiometer SW_{AC} (64) – GND(51)
Circuit tester range	Ω × 1
Standard	Ordinary state: ∞ Ω, Operated state: 0 Ω

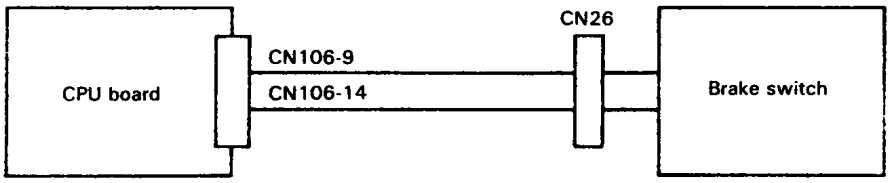




OK (ordinary state: ∞ Ω, operated state: 0 Ω) → Installation adjustment defect
NG (always 0 Ω) → Acceleration potentiometer defect

ERROR CODE A5: BRAKE SWITCH ABNORMALITY

Related portion



Estimated causes

① Brake switch defect
② CPU board defect
③ Harness (brake switch ~ CN106) defect

Is the battery plug connected without releasing the brake pedal? — YES → Is the normal state recovered when the brake pedal is released? — YES → Do not connect the battery plug with the brake pedal kept depressed.

Is the battery plug connected without releasing the brake pedal? — NO

Is the normal state recovered when the brake pedal is released? — NO

ANL 31: Switch input test
Is the brake switch ON or OFF when the brake pedal is not depressed?
See page 5-25.

- Not lit (switch OFF) → Does "A5" error occur when vibration is applied to the vehicle during traveling? — NO → CPU board defect
- Lit (switch ON)

Does "A5" error occur when vibration is applied to the vehicle during traveling? — YES

- Repeat ANL31: test again after disconnecting the brake switch connector. (to A on the next page)

- Defective contact between P1 and N1
- Defective contact of P2 wiring (see the harness diagram for A1 error.)

A

ANL 31: Switch input test
Is the brake switch ON or OFF when the brake pedal is not depressed?
See page 5-25.

- Lit (switch ON) → • Open circuit in brake switch wiring (Open on either 64 or 51 side)
- Not lit (switch OFF) →

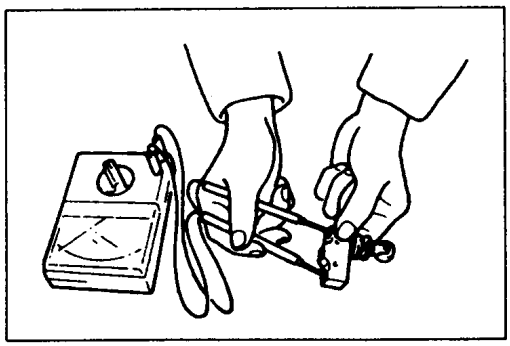
Inspection 1
Brake switch individual inspection

- NG (always ∞ Ω) → • Brake switch defect
- OK (ordinary state: 0 Ω, operated state: ∞ Ω) →

Improper installation adjustment

Inspection 1. Brake switch individual check
Brake switch removal as an individual part

Measurement terminals	Brake switch SW_B (65) – GND (51)
Circuit tester range	Ω × 1
Standard	Ordinary state: 0 Ω, Operated state: ∞ Ω

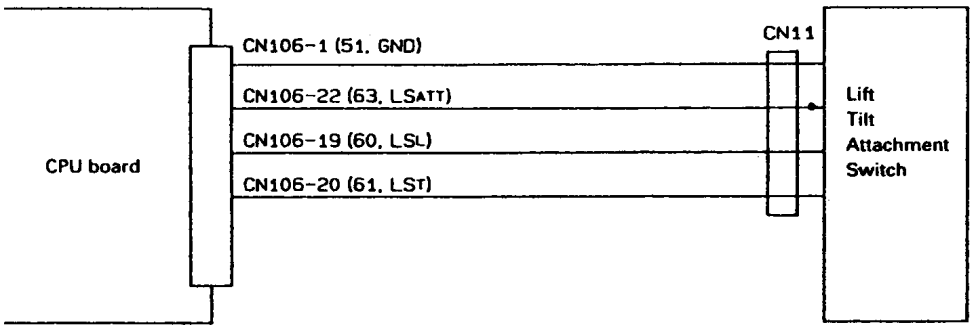


OK (ordinary state: 0 Ω, operated state: ∞ Ω) → Improper installation adjustment

NG (always ∞ Ω) → Brake switch defect

ERROR CODE A6: MATERIAL HANDLING SWITCH INSTALLATION ABNORMALITY

Related portion



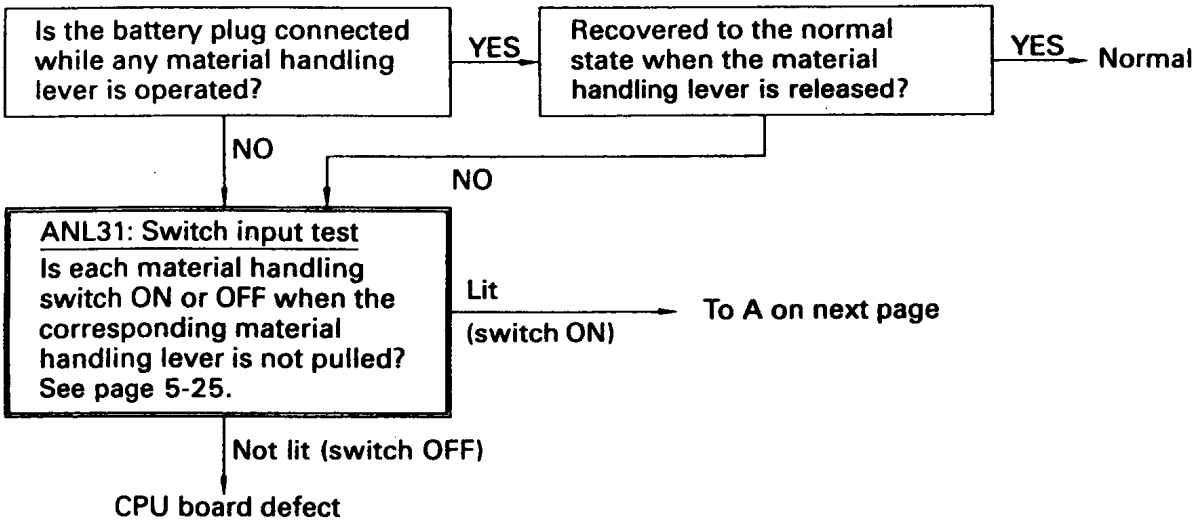
Estimated causes

① Defect of each material handling switch

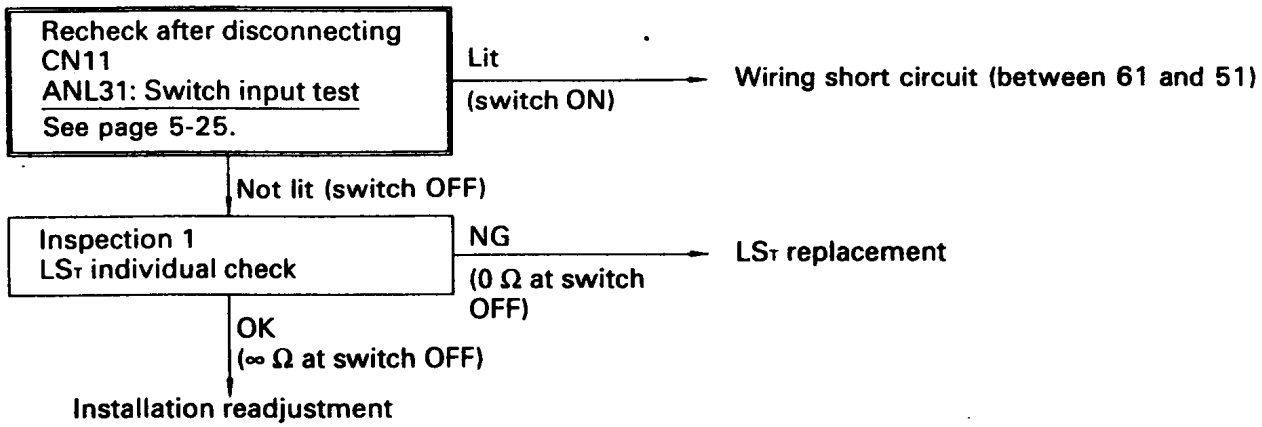
② Installation/adjustment defect of each material handling switch

③ Short circuit of each material handling switch wiring

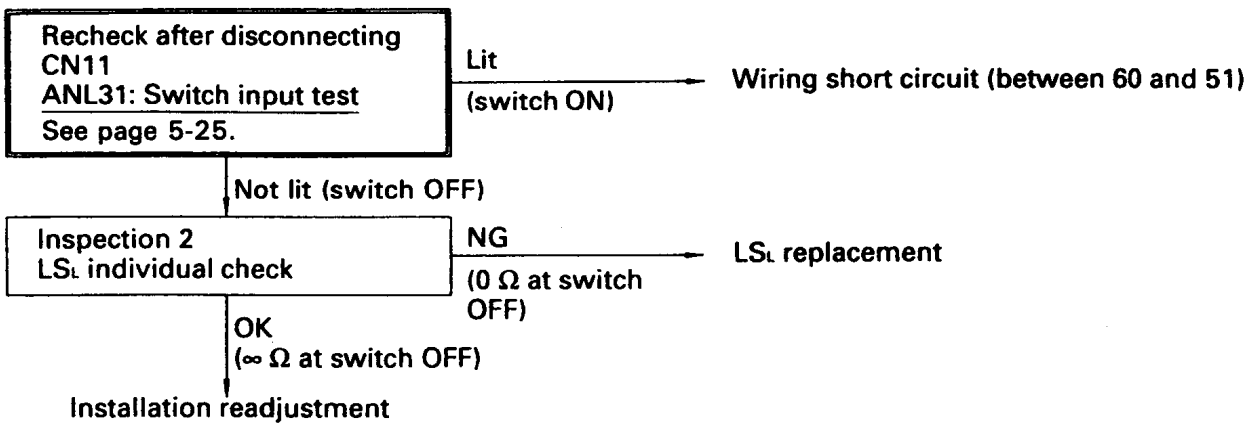
④ CPU board defect



A
(When LS_T is ON)



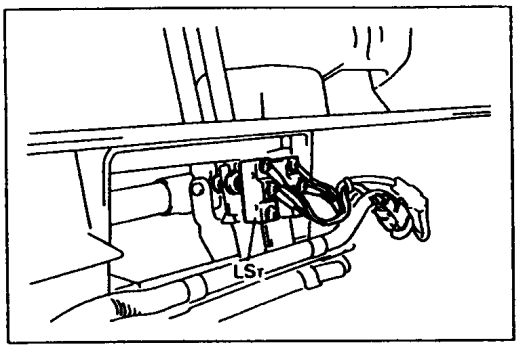
(When LS_L is ON)

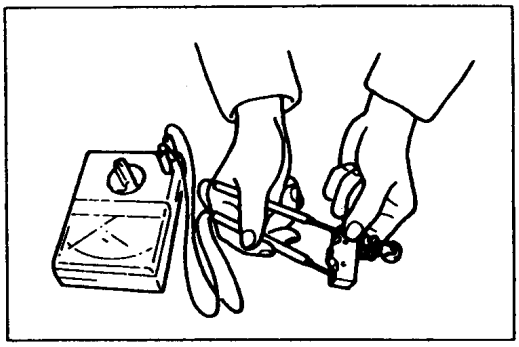


For LS_{ATT}, carry out troubleshooting in the same way as for LS_L, LS_T.

Inspection 1. LS_T individual check
LS_T individual removal

Measurement terminals	LS_T terminals
Circuit tester range	Ω × 1
Standard	∞ Ω at switch OFF

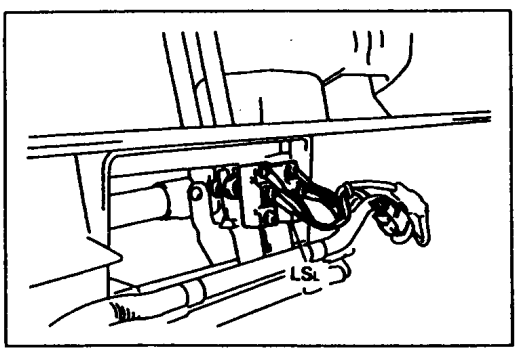


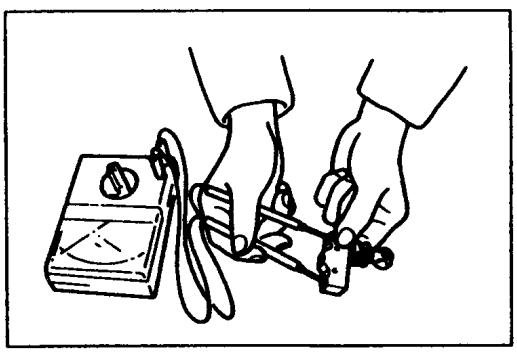


OK (∞ Ω at switch OFF) → Installation readjustment
NG (0 Ω at switch OFF) → LS_T replacement

Inspection 2. LS_L individual check
LS_L individual removal

Measurement terminals	LS_L terminals
Circuit tester range	Ω × 1
Standard	∞ Ω at switch OFF

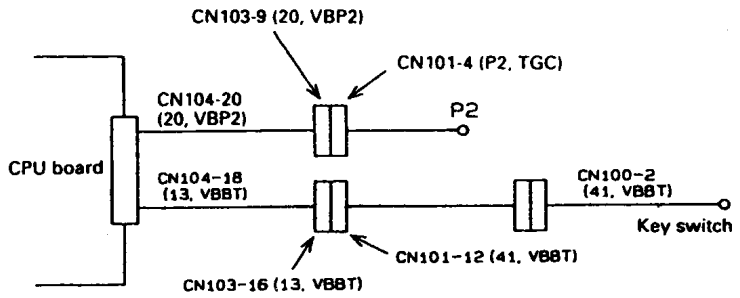




OK (∞ Ω at switch OFF) → Installation readjustment
NG (0 Ω at switch OFF) → LS_L replacement

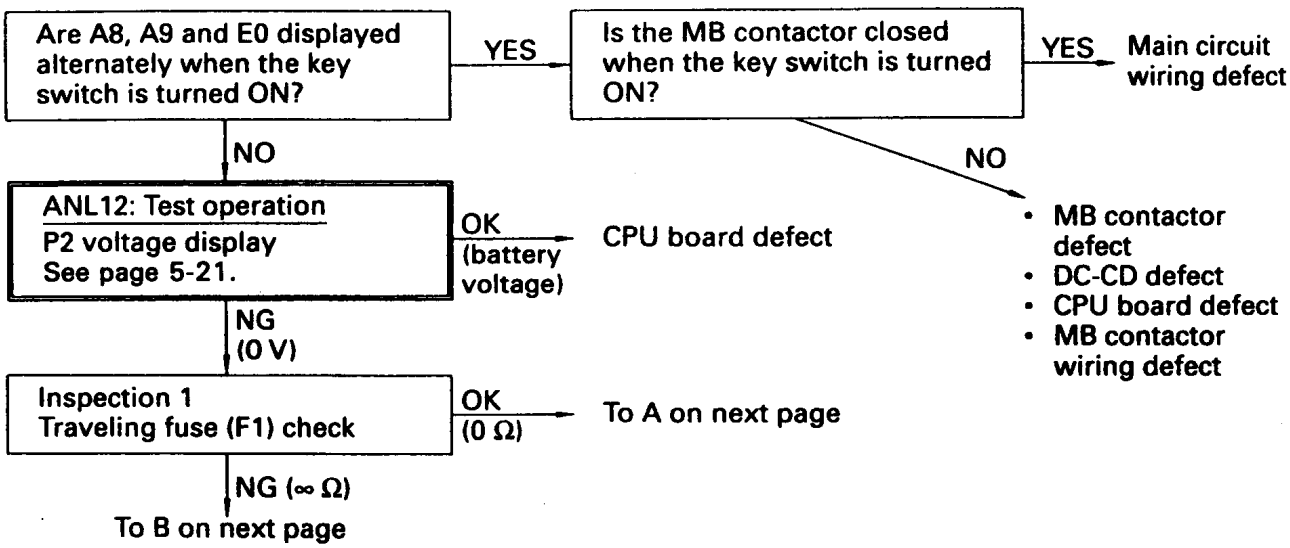
ERROR CODE A8: TRAVELING FUSE ABNORMALITY

Related portion

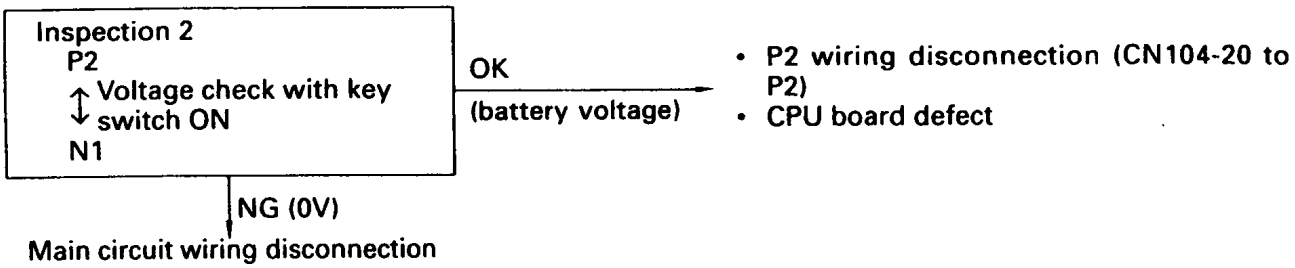


Estimated causes

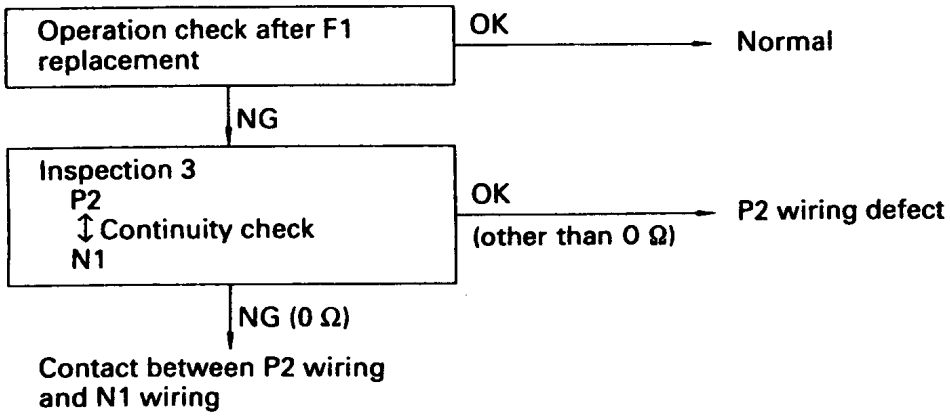
① Traveling fuse (F1) open
② P2 wiring disconnection
③ Battery cable disconnection
④ CPU board defect
⑤ MB contactor defect
⑥ DC-CD defect



A

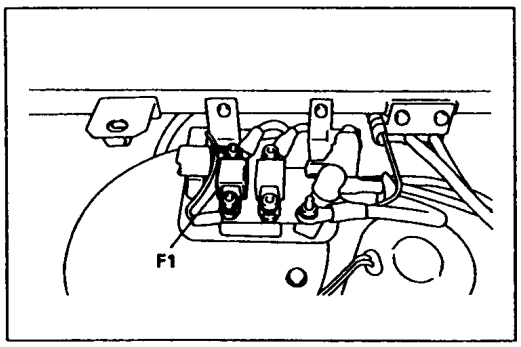

Inspection 2
P2
Voltage check with key switch ON
N1
OK
(battery voltage)
• P2 wiring disconnection (CN104-20 to P2)
• CPU board defect
NG (0V)
Main circuit wiring disconnection

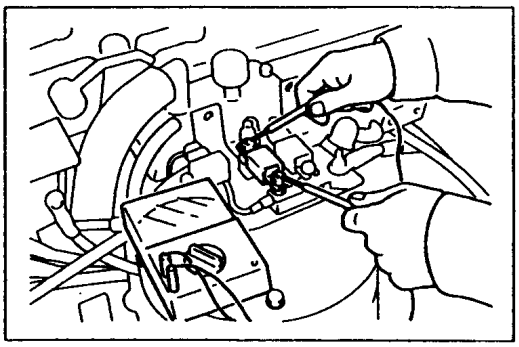
B


Operation check after F1 replacement
OK
Normal
NG
Inspection 3
P2
Continuity check
N1
OK
(other than 0 Ω)
P2 wiring defect
NG (0 Ω)
Contact between P2 wiring and N1 wiring

Inspection 1: Traveling fuse (F1) check
Battery plug OFF

Measurement terminals	Both terminals of F1
Circuit tester range	Ω × 1
Standard	0 Ω

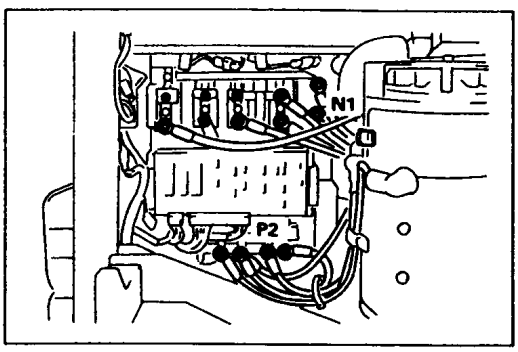


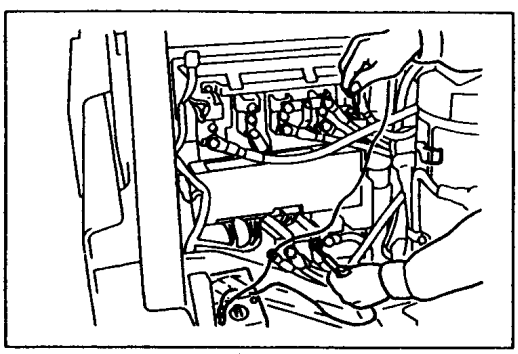


OK (0 Ω) → To inspection 2
NG (∞ Ω) → F1 replacement → To inspection 3

Inspection 2: P2 – N1 voltage check
Battery plug ON, SW_{KY} ON

Measurement terminals	P2 ⊕ – N1 ⊖
Circuit tester range	DC250V
Standard	Battery voltage

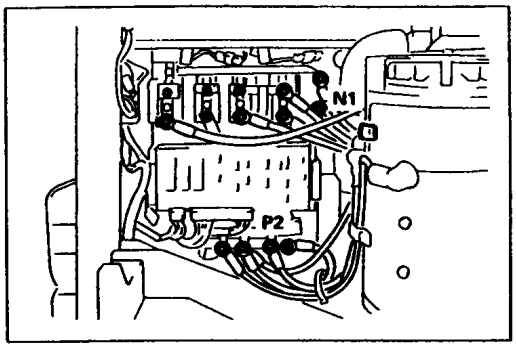


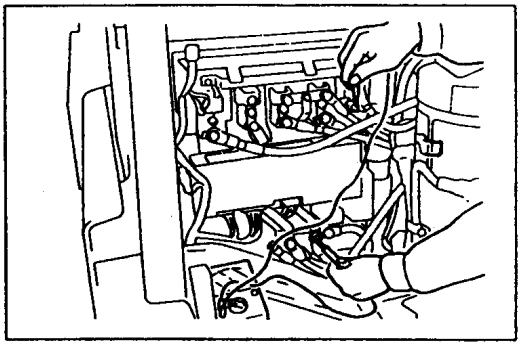


OK (battery voltage) → P2 wiring disconnection (CN104 ~ P2), CPU board defect
NG (0 V) → Main circuit wiring disconnection

Inspection 3: P2 – N1 continuity measurement
Battery plug OFF

Measurement terminals	P2 – N1
Circuit tester range	Ω × 1
Standard	Other than 0 Ω





OK (other than 0 Ω) → P2 wiring defect
NG (0 Ω) → Contact between P2 wiring and N1 wiring

ERROR CODE A9: MATERIAL HANDLING FUSE ABNORMALITY

(When displayed alternately with E0 error, priority is given to E0 error.)

(When displayed alternately with A8 error, priority is given to A8 error.)

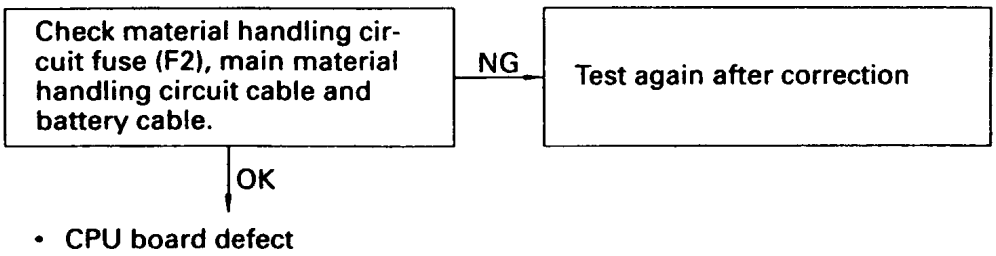
Estimated causes

① Material handling fuse (F2) open

② Main material handling circuit cable disconnection

③ CPU board defect

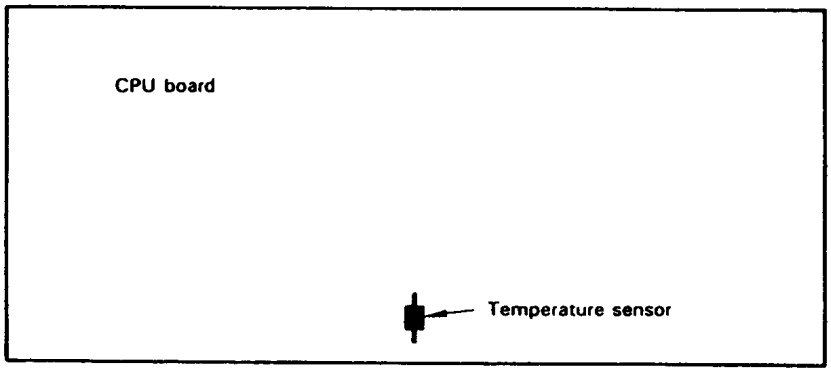
④ MB contactor mal-function



- CPU board defect

ERROR CODE AA: CPU BOARD TEMPERATURE SENSOR OUTPUT ABNORMALITY

Related portion



Estimated causes

① CPU board disconnection

ERROR CODE AE: EXCESSIVE A/D PROCESSING TIME

Estimated causes

① CPU board defect

CPU board replacement for AE display

ERROR CODE AF: CPU PROCESSING DATA ABNORMALITY

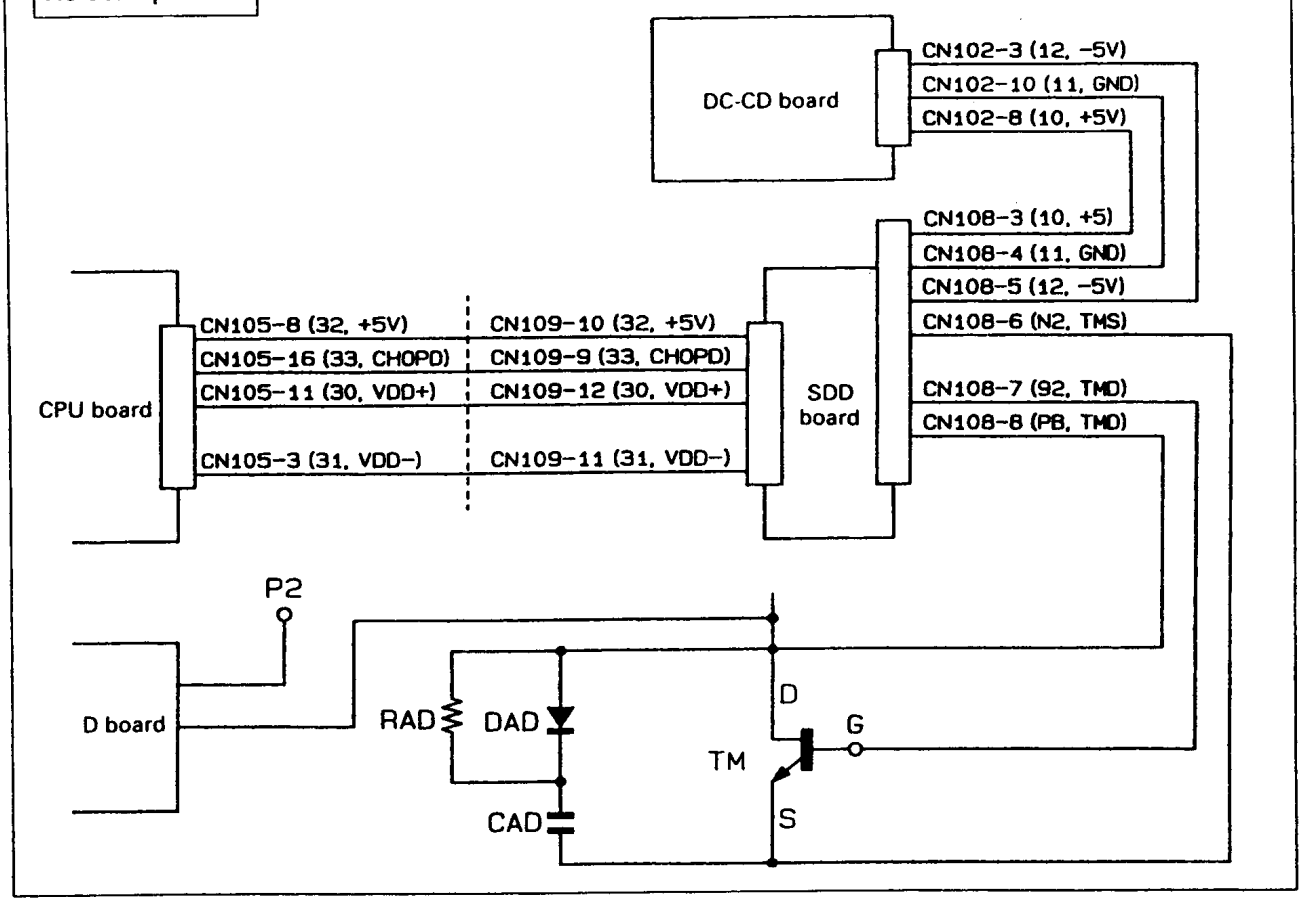
Estimated causes

① CPU board defect

CPU board replacement for AF display.

ERROR CODE C0: MAIN DRIVE CIRCUIT ABNORMALITY

Related portion



Estimated causes

① TM defect
(Check DF1, DAD, CAD, CO and RAD without fail as any of them may be the primary cause of the TM defect.)

② Main drive circuit connection defect

③ D board defect

④ TM-SDD wiring disconnection or defective contact

⑤ DC-CD – SDD wiring disconnection or defective contact

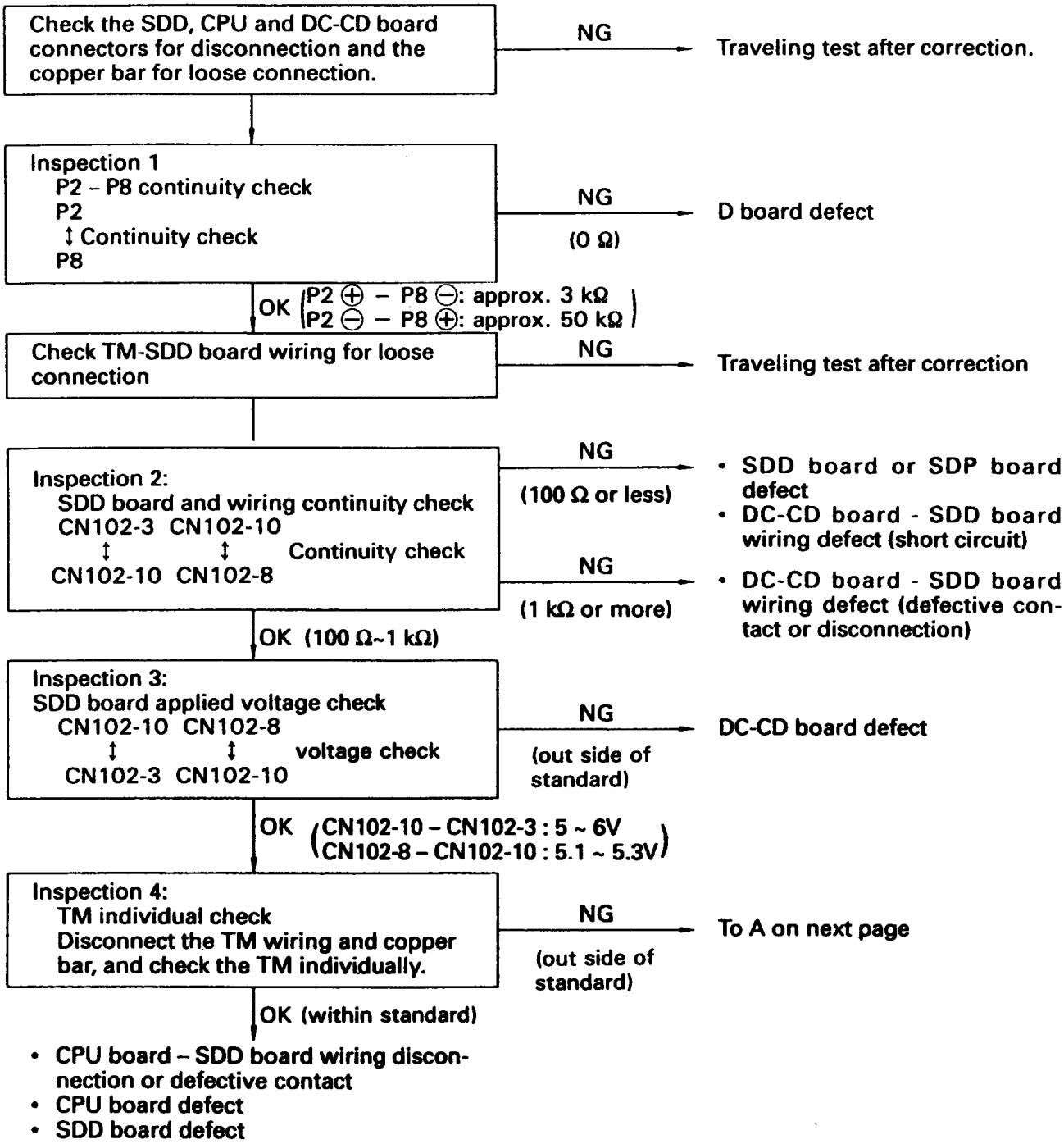
⑥ CPU – SDD wiring disconnection or defective contact

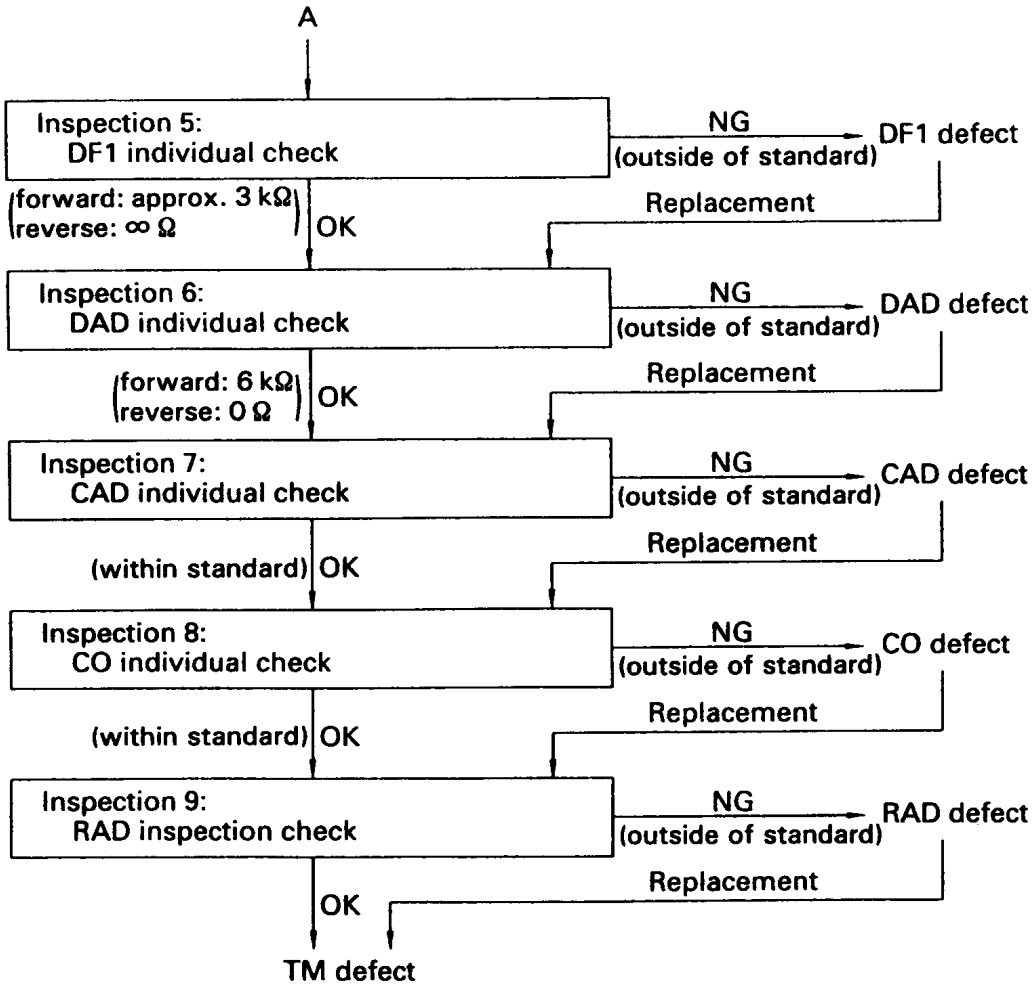
⑦ Defective contact each connector (CPU, DC-CD and SDD boards)

⑧ SDD board • SDP board defect

⑨ DC-CD board defect

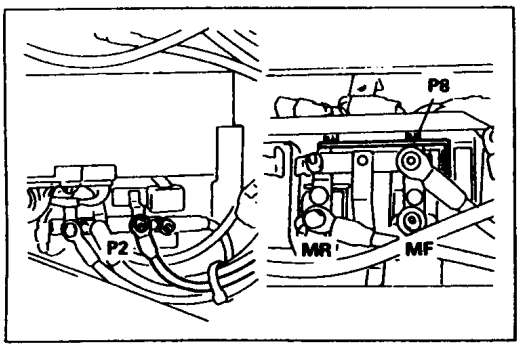
⑩ CPU board defect

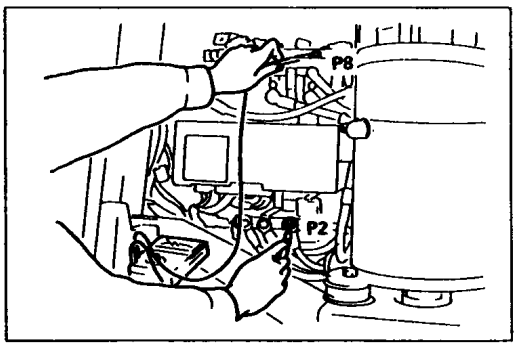

Check the SDD, CPU and DC-CD board connectors for disconnection and the copper bar for loose connection.
NG
Traveling test after correction.
Inspection 1
P2 – P8 continuity check
P2
↕ Continuity check
P8
NG
(0 Ω)
D board defect
OK (P2 ⊕ – P8 ⊖: approx. 3 kΩ
P2 ⊖ – P8 ⊕: approx. 50 kΩ)
Check TM-SDD board wiring for loose connection
NG
Traveling test after correction
Inspection 2:
SDD board and wiring continuity check
CN102-3 CN102-10
↕ ↕ Continuity check
CN102-10 CN102-8
NG
(100 Ω or less)
• SDD board or SDP board defect
• DC-CD board - SDD board wiring defect (short circuit)
NG
(1 kΩ or more)
• DC-CD board - SDD board wiring defect (defective contact or disconnection)
OK (100 Ω~1 kΩ)
Inspection 3:
SDD board applied voltage check
CN102-10 CN102-8
↕ ↕ voltage check
CN102-3 CN102-10
NG
(out side of standard)
DC-CD board defect
OK (CN102-10 – CN102-3 : 5 ~ 6V
CN102-8 – CN102-10 : 5.1 ~ 5.3V)
Inspection 4:
TM individual check
Disconnect the TM wiring and copper bar, and check the TM individually.
NG
(out side of standard)
To A on next page
OK (within standard)
• CPU board – SDD board wiring disconnection or defective contact
• CPU board defect
• SDD board defect


A
Inspection 5:
DF1 individual check
NG
(outside of standard)
DF1 defect
(forward: approx. 3 kΩ
reverse: ∞ Ω
OK
Replacement
Inspection 6:
DAD individual check
NG
(outside of standard)
DAD defect
(forward: 6 kΩ
reverse: 0 Ω
OK
Replacement
Inspection 7:
CAD individual check
NG
(outside of standard)
CAD defect
(within standard)
OK
Replacement
Inspection 8:
CO individual check
NG
(outside of standard)
CO defect
(within standard)
OK
Replacement
Inspection 9:
RAD inspection check
NG
(outside of standard)
RAD defect
OK
Replacement
TM defect

Inspection 1: P2 – P8 continuity check
Battery plug OFF, SW_{KY} OFF

Measurement terminals	P2 ⊕ – P8 ⊖ P2 ⊖ – P8 ⊕
Circuit tester range	Ω × 1 k
Standard	P2 ⊕ – P8 ⊖ : approx. 3 kΩ P2 ⊖ – P8 ⊕ : approx. 50 kΩ



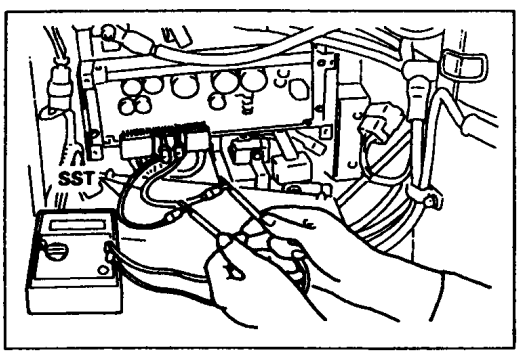


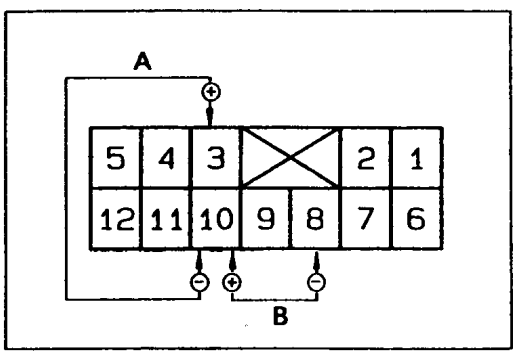
OK (P2 ⊕ – P8 ⊖: approx. 3 kΩ, P2 ⊖ – P8 ⊕: approx. 50 kΩ) → TM-SDD board wiring loosening check

NG (P2 ⊖ – P8 ⊕: ∞ Ω) → D board defect

Inspection 2: SDD board and wiring continuity check (using an analog tester)
Battery plug OFF, SW_{KY} OFF

Measurement terminals	A: CN102-3 (12) ⊕ – CN102-10 (11) ⊖ B: CN102-10 (11) ⊕ – CN102-8 (10) ⊖
Circuit tester range	Ω × k
Standard	100 Ω ~ 1 kΩ





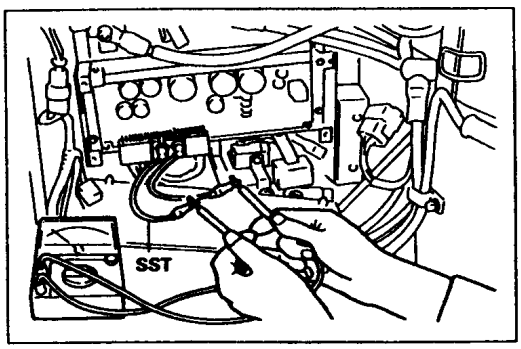
OK (100 Ω ~ 1 kΩ) → To inspection 3

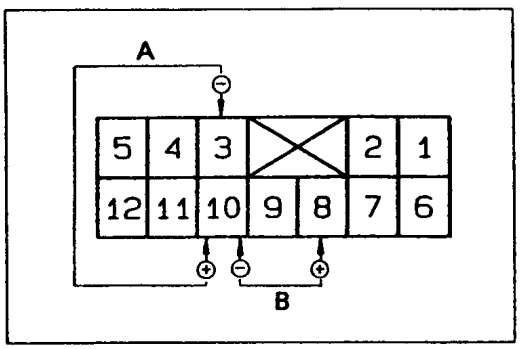
NG (100 Ω or less) → SDD board or SDP board defect, DC-CD board – SDD board wiring defect (short circuit)

NG (1 k Ω or more) → DC-CD board – SDD board wiring defect (contact defect or disconnection)

Inspection 3: SDD board applied voltage check (using a digital tester)
Battery plug ON, SW_{KY} ON

Measurement terminals	A: CN102-10 (11) ⊕ – CN102-3 (12) ⊖ B: CN102-8 (10) ⊕ – CN102-10 (11) ⊖
Circuit tester range	DC 10 V
Standard	CN102-10 ⊕ – CN102-3 ⊖: 5 ~ 6 V CN102-8 ⊕ – CN102-10 ⊖: 5.1 ~ 5.3 V

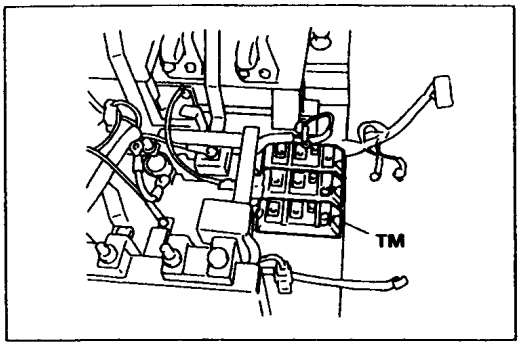


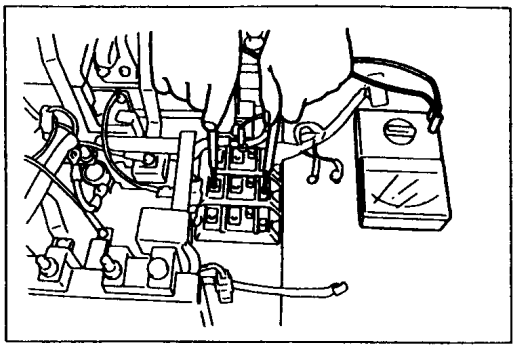


OK (within standard) → To inspection 4
NG (outside of standard) → DC-CD board defect

Inspection 4: TM individual check
Battery plug OFF, TM wiring and copper bar disconnection

Measurement terminals	Between D and S	D⊖ – S⊕ D⊕ – S⊖
	Between D and G	D⊖ – G⊕ D⊕ – G⊖
	Between G and S	G⊖ – S⊕ G⊕ – S⊖
Circuit tester range	Ω × 1 K	
Standard	Between D and S	D⊖ – S⊕: ∞ Ω D⊕ – S⊖: ∞ Ω
	Between D and G	D⊖ – G⊕: ∞ Ω D⊕ – G⊖: continuity
	Between G and S	G⊖ – S⊕: continuity G⊕ – S⊖: ∞ Ω

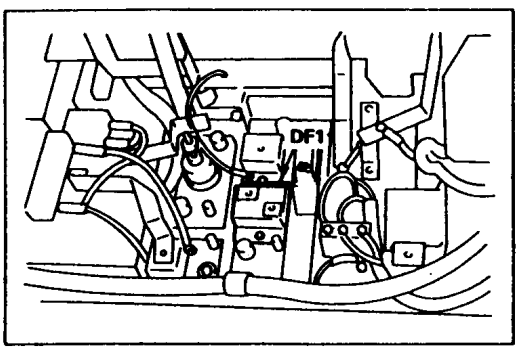


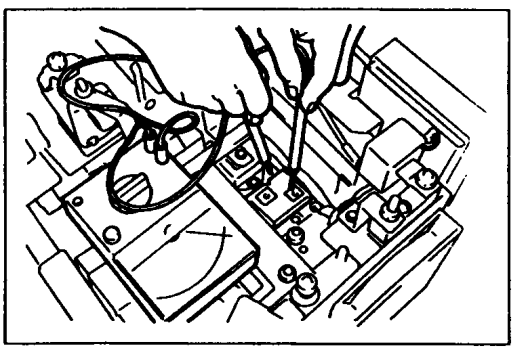


OK (within standard) → CPU board – SDD board wiring disconnection or defective contact, CPU board defect, SDD board defect
NG (outside of standard) → To inspection 5

Inspection 5: DF1 individual check
Battery plug OFF, DF1 wiring disconnection

Measurement terminals	Forward: anode ⊖ – cathode ⊕ Reverse: anode ⊕ – cathode ⊖
Circuit tester range	Ω x 1 k
Standard	Forward: Approx. 3 kΩ Reverse: ∞ Ω

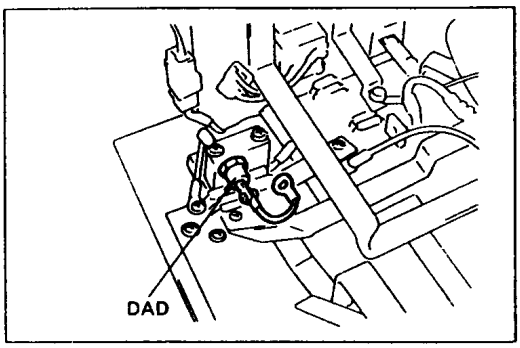


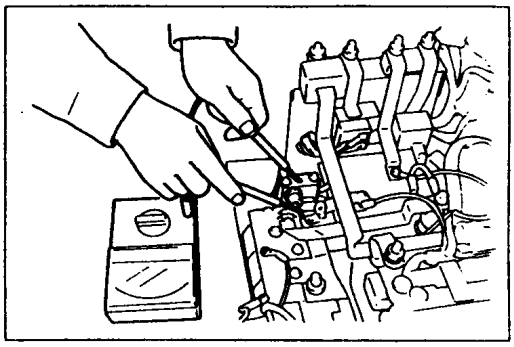


OK (forward: approx. 3 kΩ, reverse: ∞ Ω) → To inspection 6
NG (outside of standard) → DF1 defect (to inspection 6 after replacement)

Inspection 6: DAD individual check
Battery plug OFF, DAD wiring disconnection

Measurement terminals	Forward: anode ⊖ – cathode ⊕ Reverse: anode ⊕ – cathode ⊖
Circuit tester range	Ω × 1 k
Standard	Forward: approx. 6 kΩ Reverse: ∞ Ω

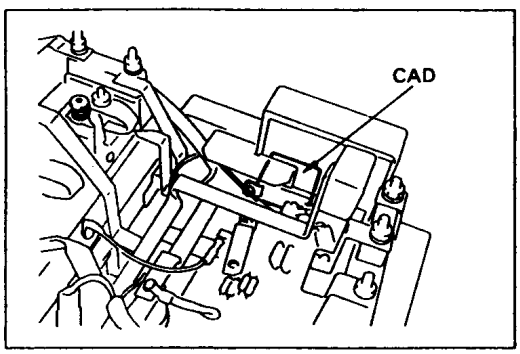


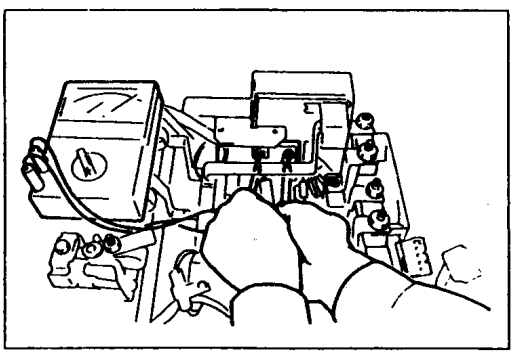


OK (forward: approx. 6 kΩ, reverse: ∞ Ω) → To inspection 7
NG (outside of standard) → DAD defect (to inspection 7 after replacement)

Inspection 7: CAD individual check
Battery plug OFF, CAD wiring disconnection

Measurement terminals	Both terminals of CAD
Circuit tester range	Ω × 1 k
Standard	When tester probes are brought into contact with both terminals of CAD, the pointer shall deflect once toward the 0 Ω side, return gradually toward ∞ Ω and finally indicate ∞ Ω. This is because the capacitor is charged by the circuit tester current.

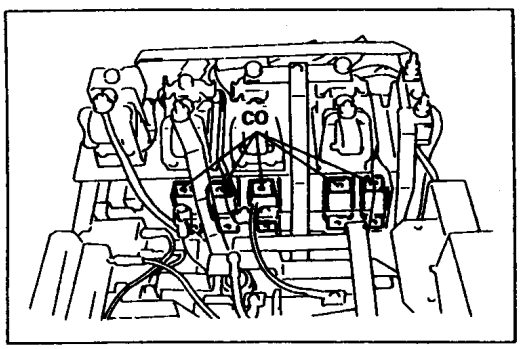


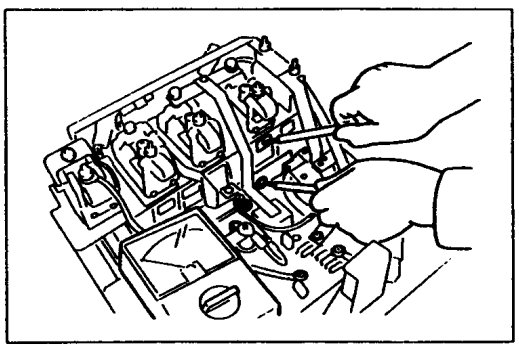


OK (within standard) → To inspection 8
NG (outside of standard) → CAD defect (to inspection 8 after replacement)

Inspection 8: CO individual check
Battery plug OFF, CO wiring disconnection

Measurement terminals	Both terminals of CO
Circuit tester range	Ω × 1 k
Standard	When tester probes are brought into contact with both terminals of CO, the pointer shall deflect once toward the 0 Ω side, return gradually toward ∞ Ω and finally indicate ∞ Ω. This is because the capacitor is charged by the circuit tester current.

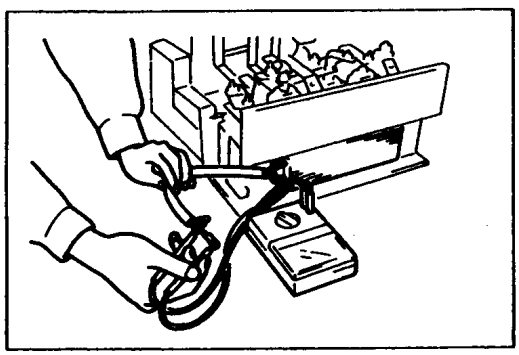




OK (within standard) → To inspection 9
NG (outside of standard) → CO defect (to inspection 9 after replacement)

Inspection 9: RAD individual check
Battery plug OFF, RAD wiring disconnection

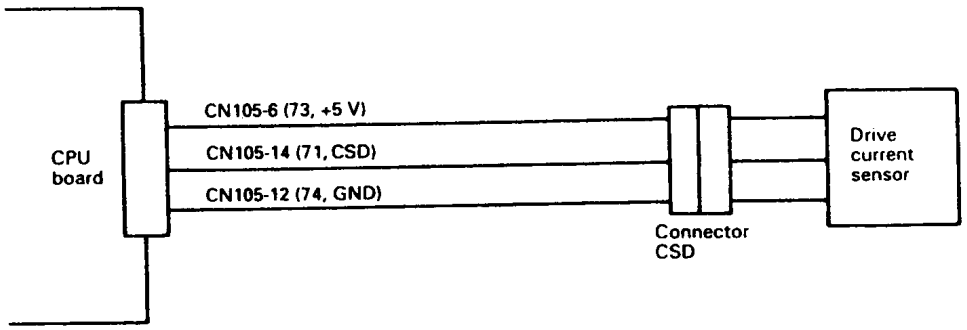
Measurement terminals	Both terminals of RAD
Circuit tester range	Ω × 1 k
Standard	Approx. 1.5 Ω



OK (approx. 1.5 Ω) → TM defect
NG (∞ Ω) → RAD defect (Inspect the TM after replacement, and replace if defective.)

ERROR CODE C1: DRIVE CIRCUIT CURRENT SENSOR ABNORMALITY

Related portion



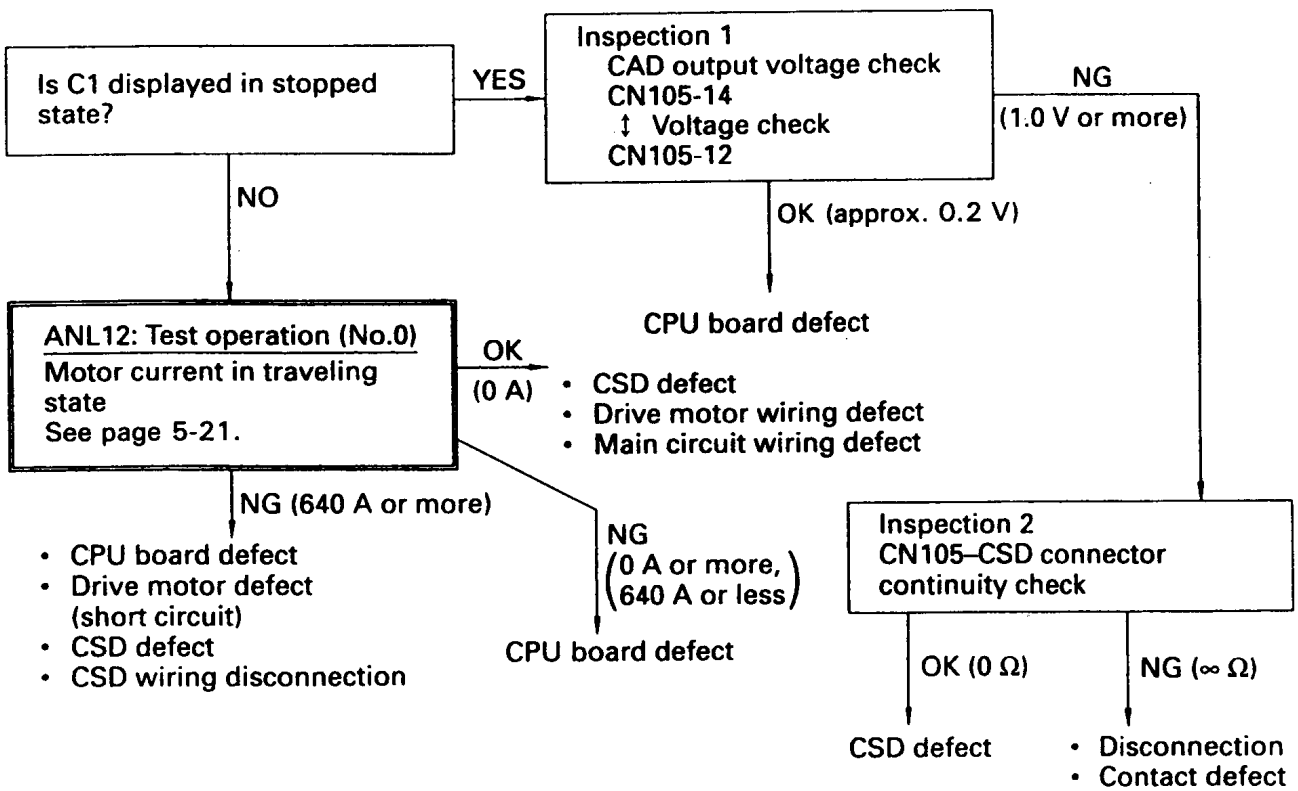
Estimated causes

① Drive current sensor defect

② Disconnection or defective connector contact between CN105 and traveling current sensor

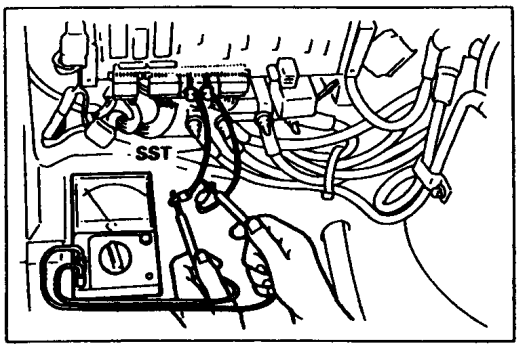
③ Drive motor defect (short circuit)

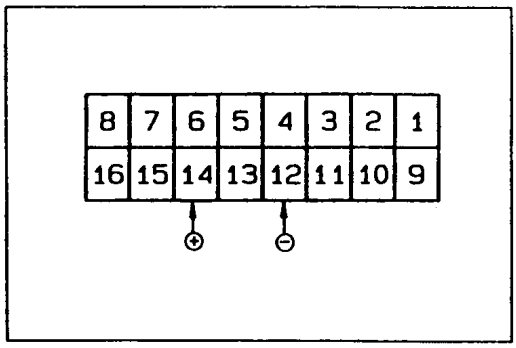
④ CPU board defect



Inspection 1: CSD output voltage check
Battery plug ON, SW_{KY} ON

Measurement terminals	CN105-14 (71) ⊕ – CN105-12 (74) ⊖
Circuit tester range	DC 10 V
Standard	Approx. 0.2 V

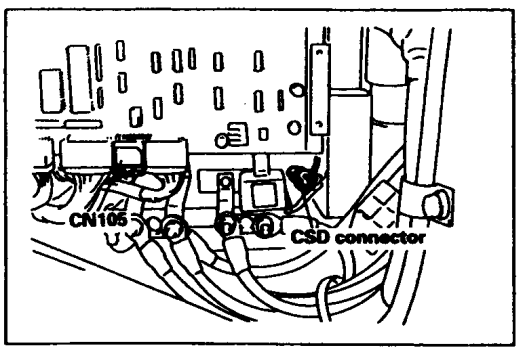


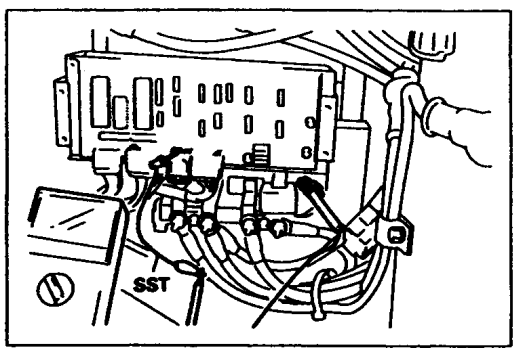


OK (approx. 0.2 V) → CPU board defect
NG (1.0 V or more) → To inspection 2

Inspection 2: CN105-CSD connector continuity check
Battery plug OFF

Measurement terminals	CN105-14 (71) – CSD connector
Circuit tester range	Ω × 1
Standard	0 Ω

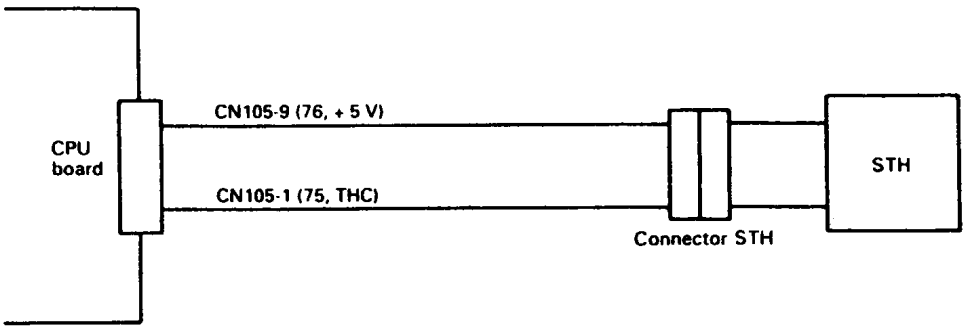




OK (0 Ω) → CSD defect
NG (∞ Ω) → Disconnection, Contact defect

ERROR CODE C3: CONTROLLER TEMPERATURE SENSOR ABNORMALITY

Related portion



Estimated causes

① Controller temperature sensor abnormality

② Defective contact between CN105 and connector STH

③ Open circuit between CN105 and controller temperature sensor

④ CPU board defect

Inspection 1
Check disconnection of connector CN105 and connector STH.

NG → Display check after correction

OK

ANL12: Test operation (No. 9)
Is the temperature sensor voltage 0 V?
See page 5-21.

YES (0 V) → Inspection 2
Disconnect connector STH and measure the resistance of temperature sensor. Is it between 10 Ω and 10 kΩ?

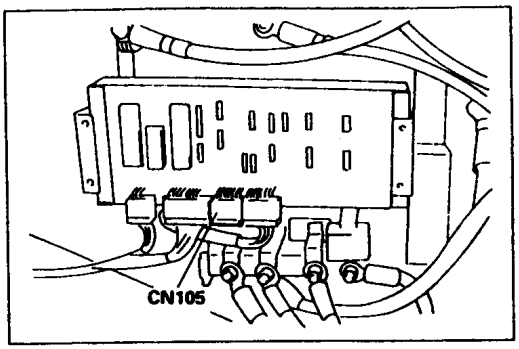
NO → Temperature sensor defect

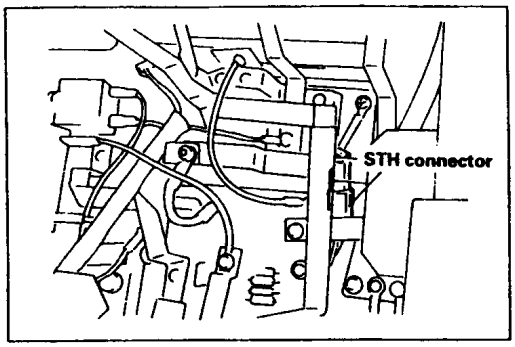
NO (other than 0 V) → CPU board defect

YES (between 10 Ω and 10 kΩ)

- Wiring disconnection
- Defective connector contact

Inspection 1. CN105 connector and connector STH disconnection check

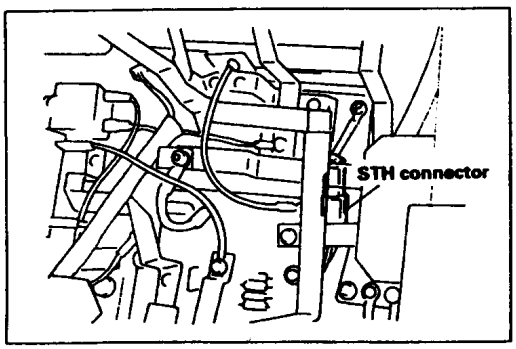


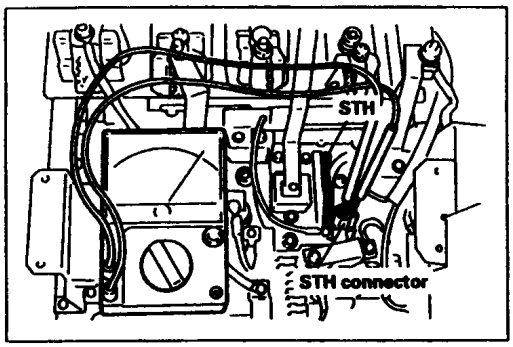


OK → To ANL12: test operation
NG → Display check after correction

Inspection 2. Temperature sensor resistance measurement
Battery plug OFF

Measurement terminals	Both terminals of temperature sensor connector STH
Circuit tester range	Ω × 1
Standard	Between 10 Ω and 10 kΩ

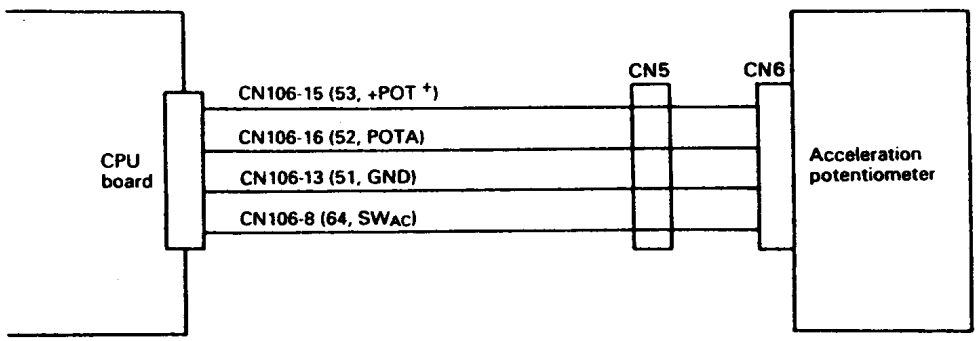




YES (between 10 Ω and 10 kΩ) → Wiring disconnection, Defective connector contact
NO (outside of standard) → Temperature sensor defect

ERROR CODE C4: TRAVELING ACCELERATOR ABNORMALITY

Related portion



Estimated causes

① Acceleration potentiometer defect
② Short circuit or open circuit in wiring between CN106 and acceleration potentiometer
③ Defective contact of CN106·CN5·CN6 and accelerator connector
④ CPU board defect

Check disconnection of CN106·CN5·CN6 and accelerator connector
→ NG → Traveling test after connecting each connector
↓ OK

ANL11: ESY-15
(acceleration potentiometer check)
Check the potentiometer voltage when the accelerator pedal is not depressed.
See page 5-18.
→ NG (0.0 V) → To A on next page
↓ OK (0.1 V or more)

ANL11: ESY-15
(acceleration potentiometer check)
Check the potentiometer voltage when the accelerator pedal is fully depressed.
See page 5-18.
→ NG (4.1 V or more) → To B on next page
↓ OK (4.0 V or less)

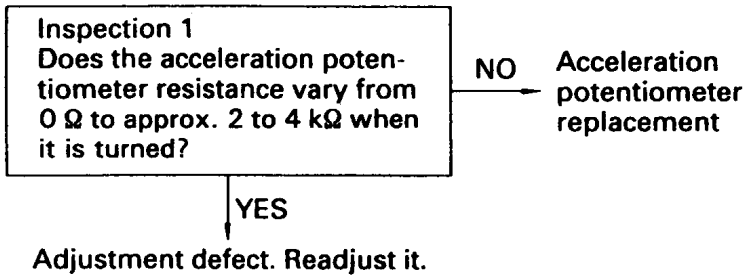
ANL11: ESY-15
(acceleration potentiometer check)
Check the potentiometer voltage when the switch is turned from OFF to ON while depressing the accelerator pedal gradually. See page 5-18.
→ NG (* not turned ON or 1.4 V or more) → Disconnection at CN106-8 and disconnection or short circuit with other portion at CN106-13
↓ OK (1.3 V or less)

CPU board defect

*** The acceleration potentiometer is defective if the switch is not turned ON.**

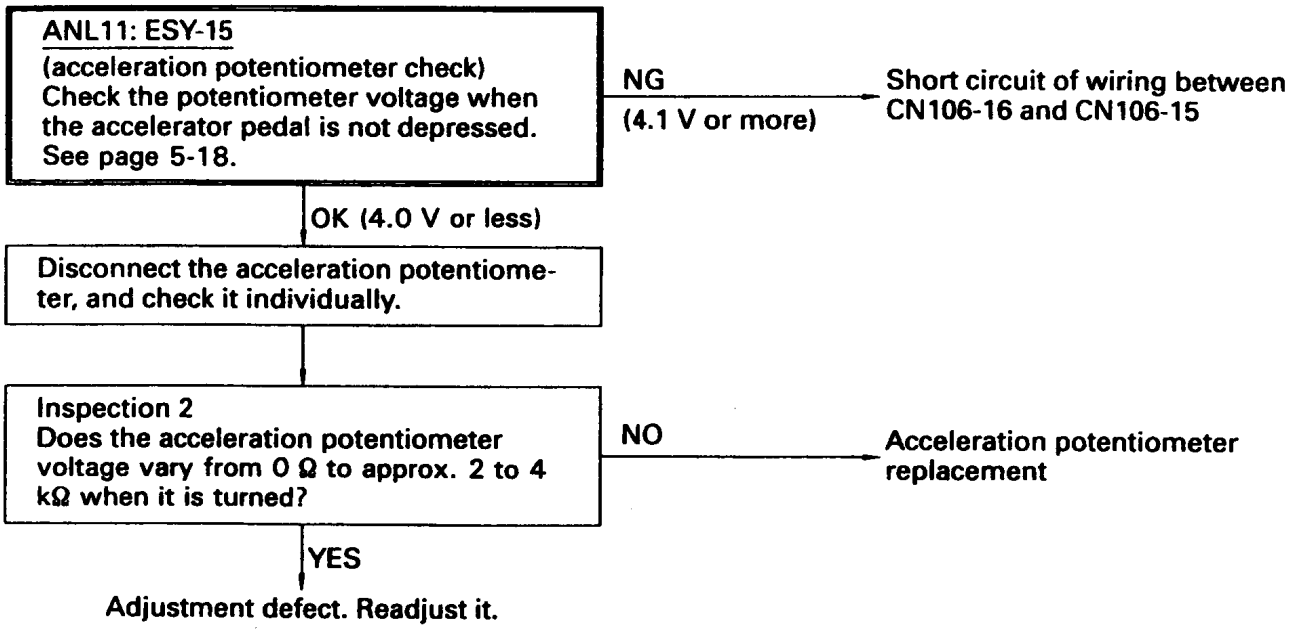
A

Disconnect the acceleration potentiometer and check it individually.



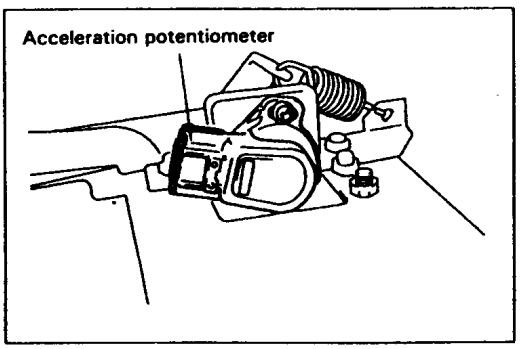
B

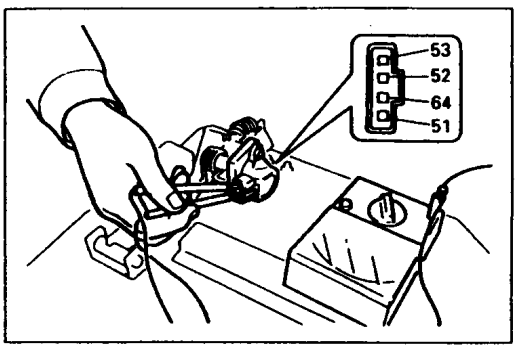
Recheck after disconnecting the acceleration potentiometer connector.



Inspection 1. Individual acceleration potentiometer measurement
Battery plug OFF

Measurement terminals	Terminals of acceleration potentiometer connector
,Circuit tester range	Ω × 1K
Standard	Variation from 0 Ω to approx. 2 ~ 4 kΩ



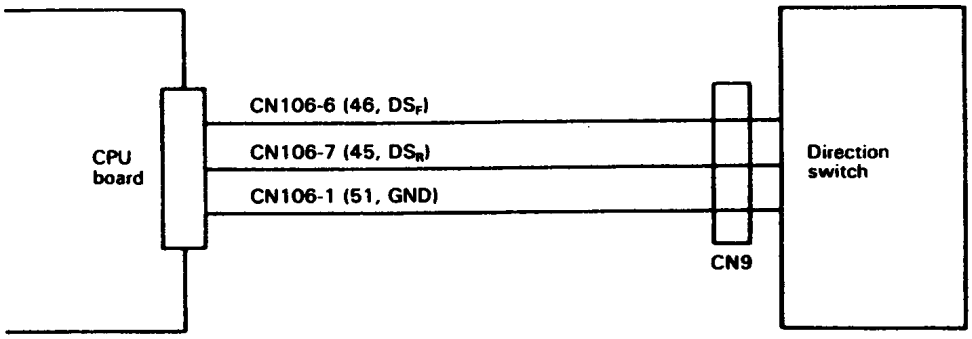


YES (variation from 0 Ω to approx. 2 ~ 4 kΩ) → Adjustment defect, readjust it.
NO (outside of standard) → Acceleration potentiomenter replacement

Inspection 2. Individual acceleration potentiometer check
Same operation as inspection 1

ERROR CODE C7: DIRECTION SWITCH ABNORMALITY

Related portion



Estimated causes

① Direction switch defect

② Short circuit or disconnection in wiring between CN106 and direction switch

③ CPU board defect

Check if CN106 connector is disconnected.

NG → Confirmation test after correction

OK ↓

ANL31: Switch input test
When the direction lever is operated to the forward or reverse position, is the opposite direction also set to ON?
See page 5-25.

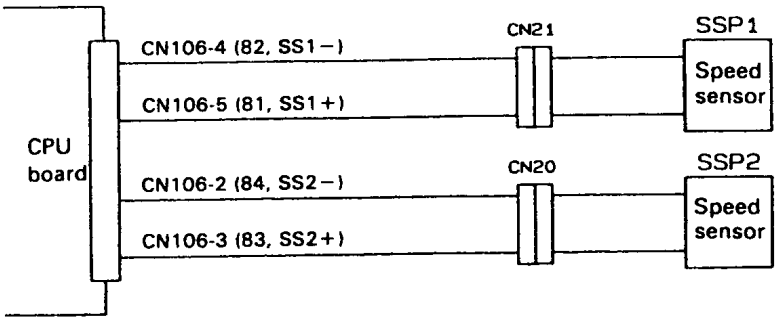
NO →
- Direction switch defect
- Short circuit or disconnection of wiring

YES ↓

CPU board defect

ERROR CODE C8: SPEED SENSOR ABNORMALITY

Related portion



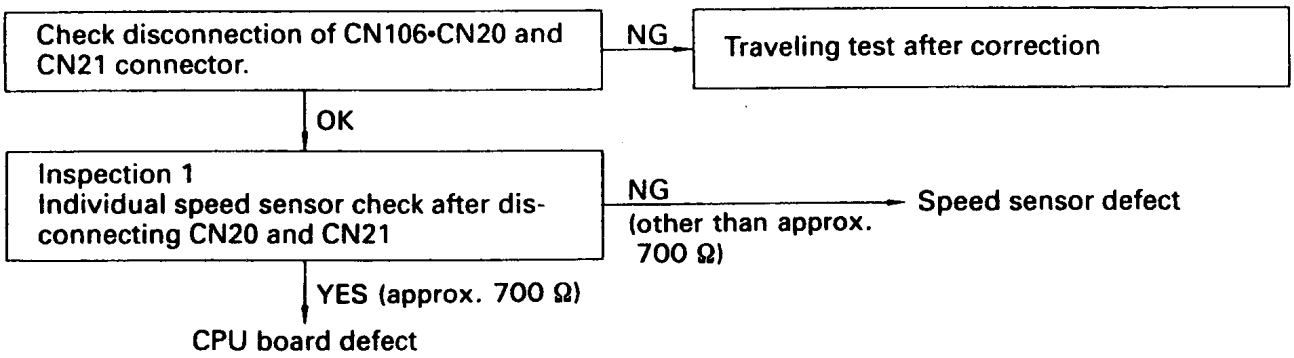
Estimated causes

① Speed sensor defect (coil disconnection)

② Disconnection in wiring between CN106 and speed sensor

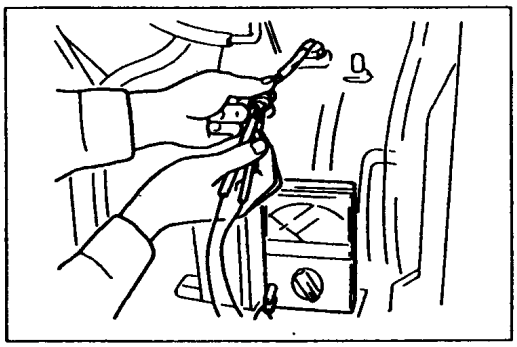
③ Connector contact defect

④ CPU board defect



Inspection 1. Individual speed sensor measurement
Battery plug OFF

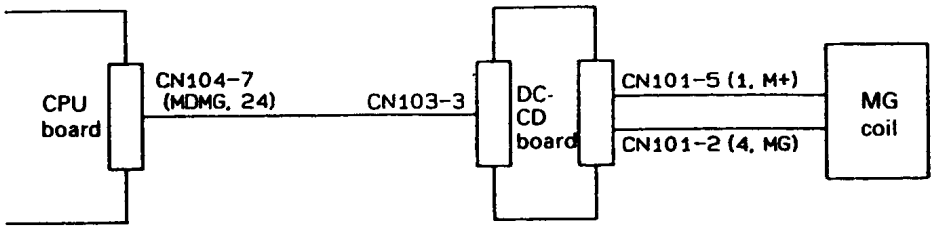
Measurement terminals	Terminals of speed sensor connector
Circuit tester range	Ω x 1
Standard	Approx. 700 Ω



OK (approx. 700 Ω) → CPU board defect
NG (other than approx. 700 Ω) → Speed sensor replacement

ERROR CODE C9: REGENERATIVE CONTACTOR ABNORMALITY

Related portion



Estimated causes

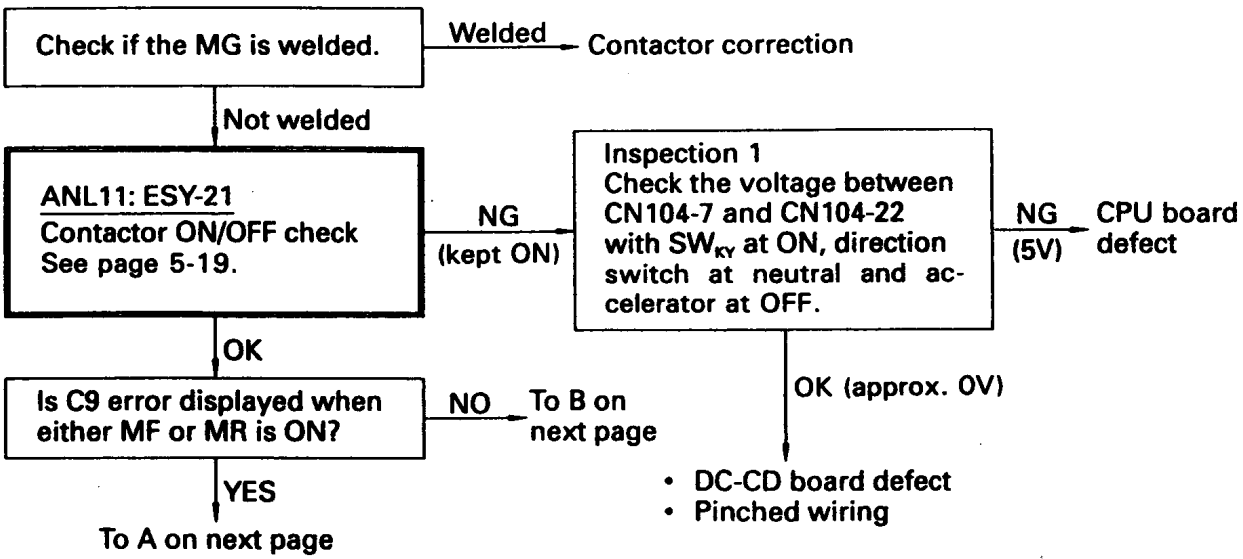
① MG defect

② DC-CD board defect

③ DF1•DF2•TG defect

④ CPU board defect

⑤ Wiring harness defect



A

Inspection 2
DF1 individual check

NG → DF1 defect
(outside of standard)

OK (forward: approx. 3 kΩ
reverse : ∞ Ω)

D board defect

B

Inspection 3
DF2 and TG individual check

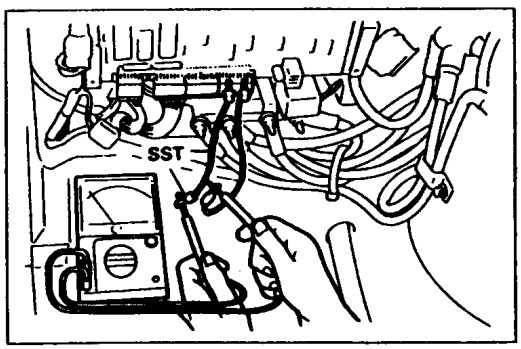
NG → DF2 or TG defect
(outside of standard)

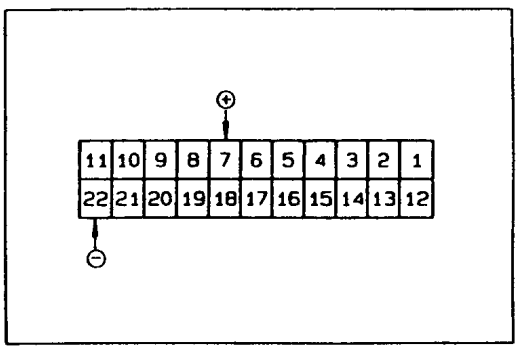
OK (within standard)

- D board defect
- DC-CD board defect

Inspection 1: MG contactor ON signal check
Battery plug ON, SW_{KY} ON, direction switch N (neutral) Accelerator switch OFF

Measurement terminals	CN104-7 (24) ⊕ — CN104-22 (N2) ⊖
Circuit tester range	DC 10 V
Standard	Approx. 0 V

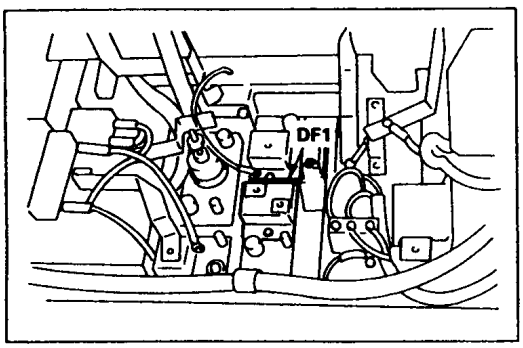


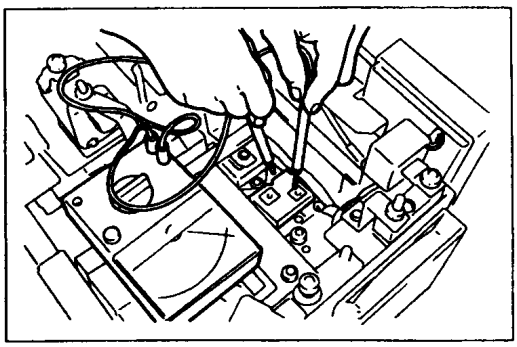


OK (approx. 0 V) → DC-CD board defect, pinched wiring
NG (5 V) → CPU board defect

Inspection 2: DF1 individual check
Battery plug OFF, DF1 wiring disconnection

Measurement terminals	Forward: anode ⊖ – cathode ⊕ Reverse: anode ⊕ – cathode ⊖
Circuit tester range	Ω × 1 k
Standard	Forward: approx. 3 kΩ Reverse: ∞ Ω



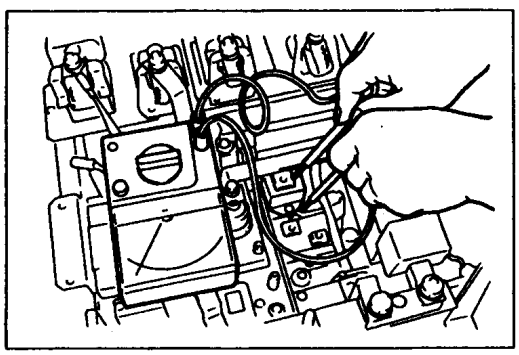


OK (forward: approx. 3 k Ω, reverse: ∞ Ω) → D board replacement
NG (outside of standard) → DF1 defect

Inspection 3: DF2, TG individual check
Battery plug OFF, DF2 wiring disconnection

DF2

Measurement terminals	Forward: anode ⊖ – cathode ⊕ Reverse: anode ⊕ – cathode ⊖
Circuit tester range	Ω × 1 k
Standard	Forward: approx. 6 kΩ Reverse: ∞ Ω

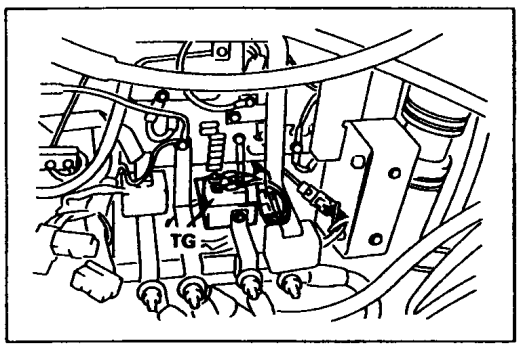


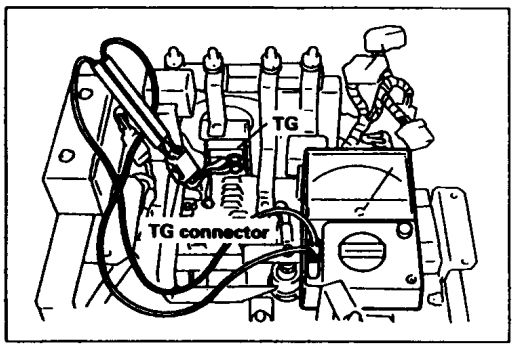
OK (forward: approx. 6 k Ω, reverse: ∞ Ω) → D board replacement, DC-CD board replacement
NG (outside of standard) → DF2 defect

Battery plug OFF, TG wiring disconnection

TG

Measurement terminals	Between B and C	B ⊖ — C ⊕ B ⊕ — C ⊖
	Between C and E	C ⊖ — E ⊕ C ⊕ — E ⊖
Circuit tester range	Ω × 1 k	
Standard	Between B and C	B ⊖ — C ⊕ : continuity shall exist B ⊕ — C ⊖ : ∞ Ω
	Between C and E	C ⊖ — E ⊕ : ∞ Ω C ⊕ — E ⊖ : continuity shall exist

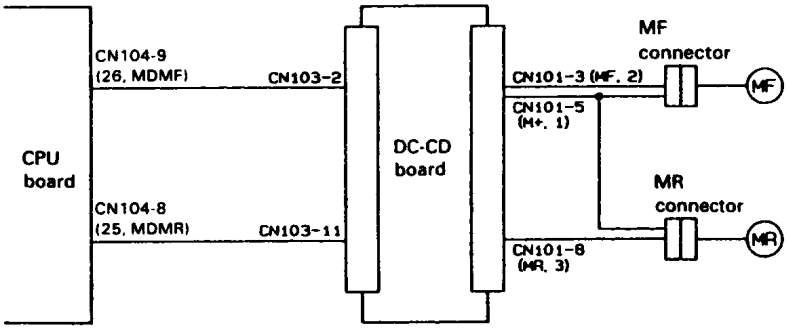




OK (within standard) → D board defect, DC-CD board defect
NG (outside of standard) → TG defect

ERROR CODE CA: FORWARD/REVERSE CONTACTOR DEFECT

Related portion



Estimated causes

① MF•MR defect

② DC-CD board defect

③ CPU board defect

④ Wiring defect

ANL11: ESY-19,20
Contactor ON/OFF check
See page 5-19.

NO (other than conditions for Yes)

Inspection 1
Check the voltage between CN104-8 and CN104-22 and the voltage between CN104-9 and CN104-22 with SW_{KY} set to ON and direction switch set to neutral.

NG (0V) → CPU board defect

OK (approx. 5V)

- Harness defect
- Contactor coil open
- DC-CD board defect

YES (YES condition)

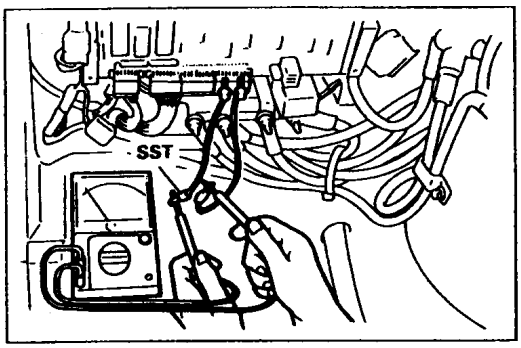
Conditions for Yes
- Contactor closed and "H" for short circuit display
- Contactor not closed and "H" for open circuit display

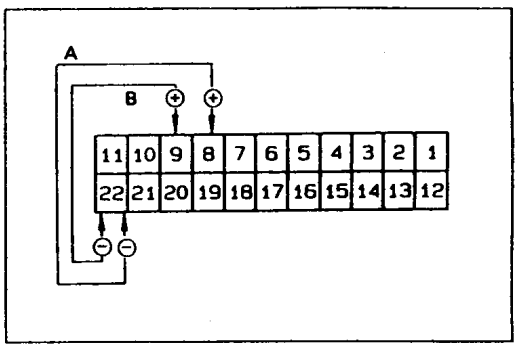
YES

DC-CD board defect

Inspection 1: MF-MR contactor ON signal check
Battery plug ON, SW_{KY} ON and direction switch ON

Measurement terminals	A: CN104-8 (25) ⊕ – CN104-22 (N2) ⊖ B: CN104-9 (26) ⊕ – CN104-22 (N2) ⊖
Circuit tester range	DC 10 V
Standard	Approx. 5V

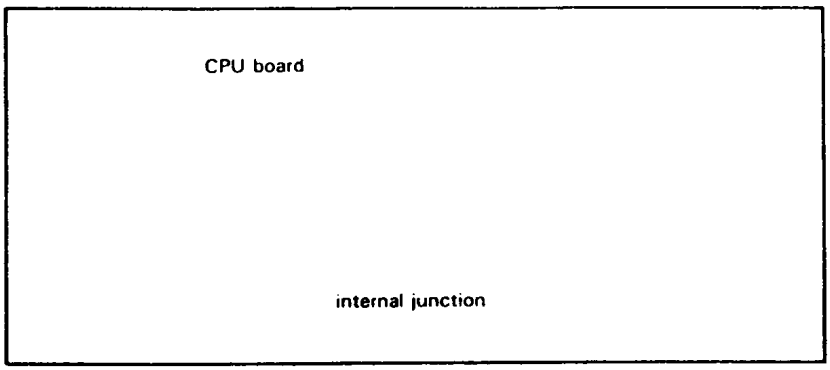




OK (approx. 5 V) → Harness defect, contactor coil open, DC-CD board defect
NG (0 V) → CPU board defect

ERROR CODE CC: TRAVELING OCL VALUE ABNORMAL DROP

Related portion



Estimated causes

① CPU board defect

Traveling OCL value measurement
See page 4-26.

NG → CSD defect
(outside of standard ± 5%)

OK (standard ± 5%)

CPU board defect

ERROR CODE CE:CPU ROM ABNORMALITY

Estimated causes

① CPU board defect

Replace the CPU board as the corrective action when CE is displayed.

ERROR CODE CF: CPU RAM DEFECT

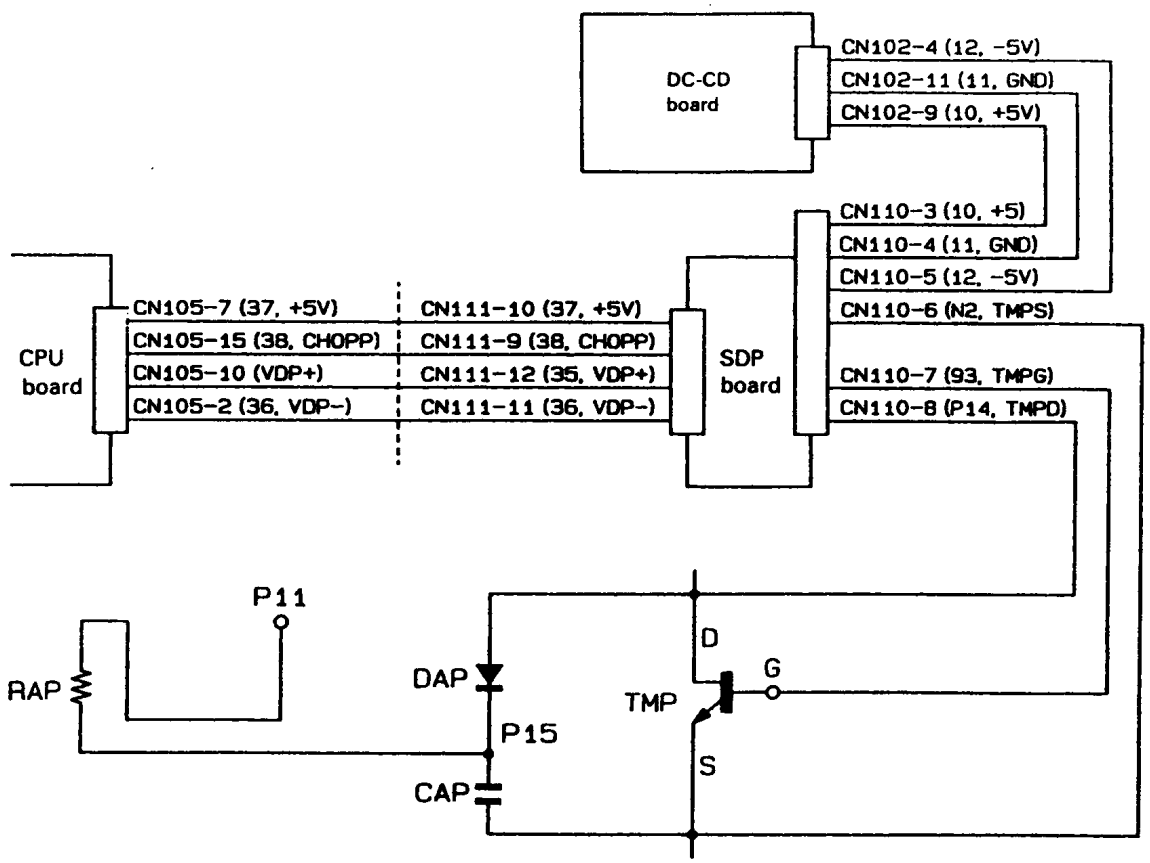
Estimated causes

① CPU board defect

Replace the CPU board as the corrective action when CF is displayed.

ERROR CODE E0: MAIN MATERIAL HANDLING CIRCUIT ABNORMALITY

Related portion



Estimated causes

① TMP defect
(Also check DF3, DAP, CAP, and RAP without fail as any of them may be the primary cause of the TMP defect.)

② TMP—SDP wiring disconnection or defective contact

③ DC-CD—SDP wiring disconnection or defective contact

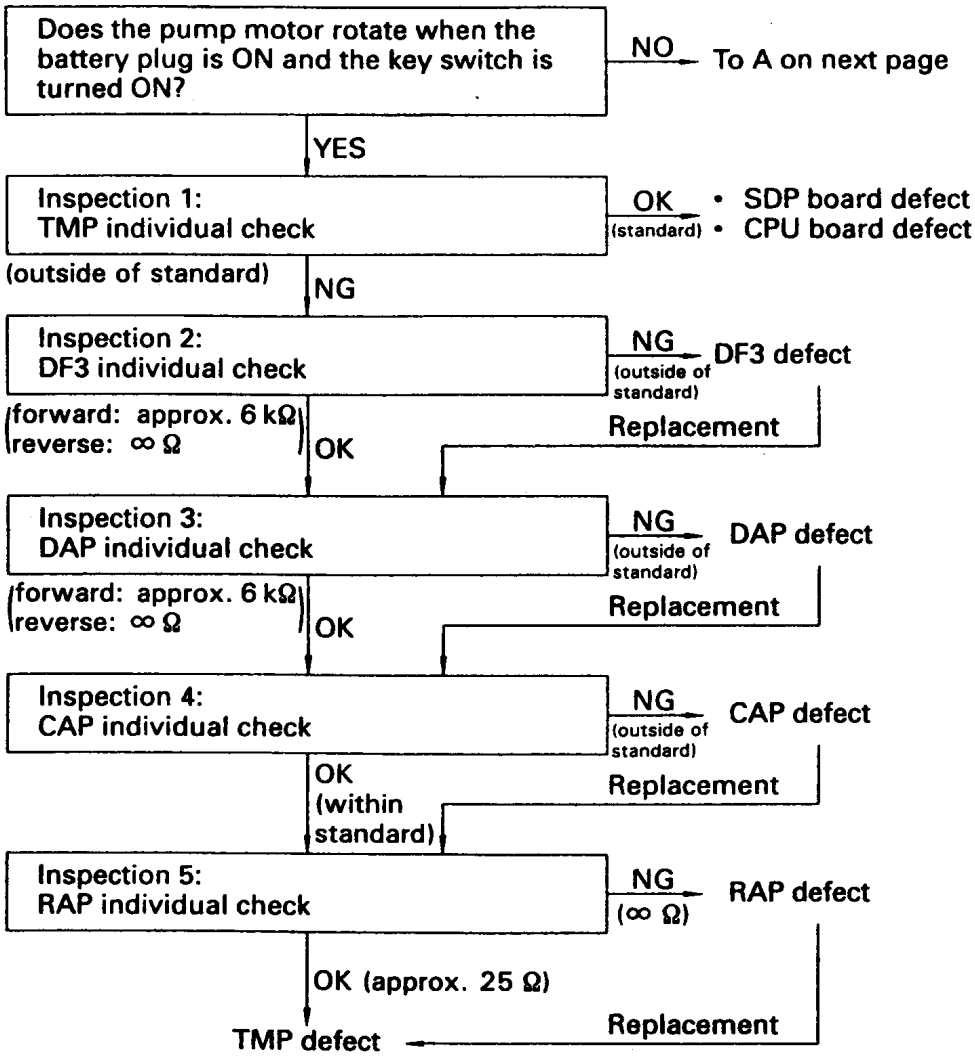
④ CPU—SDP wiring disconnection or defective contact

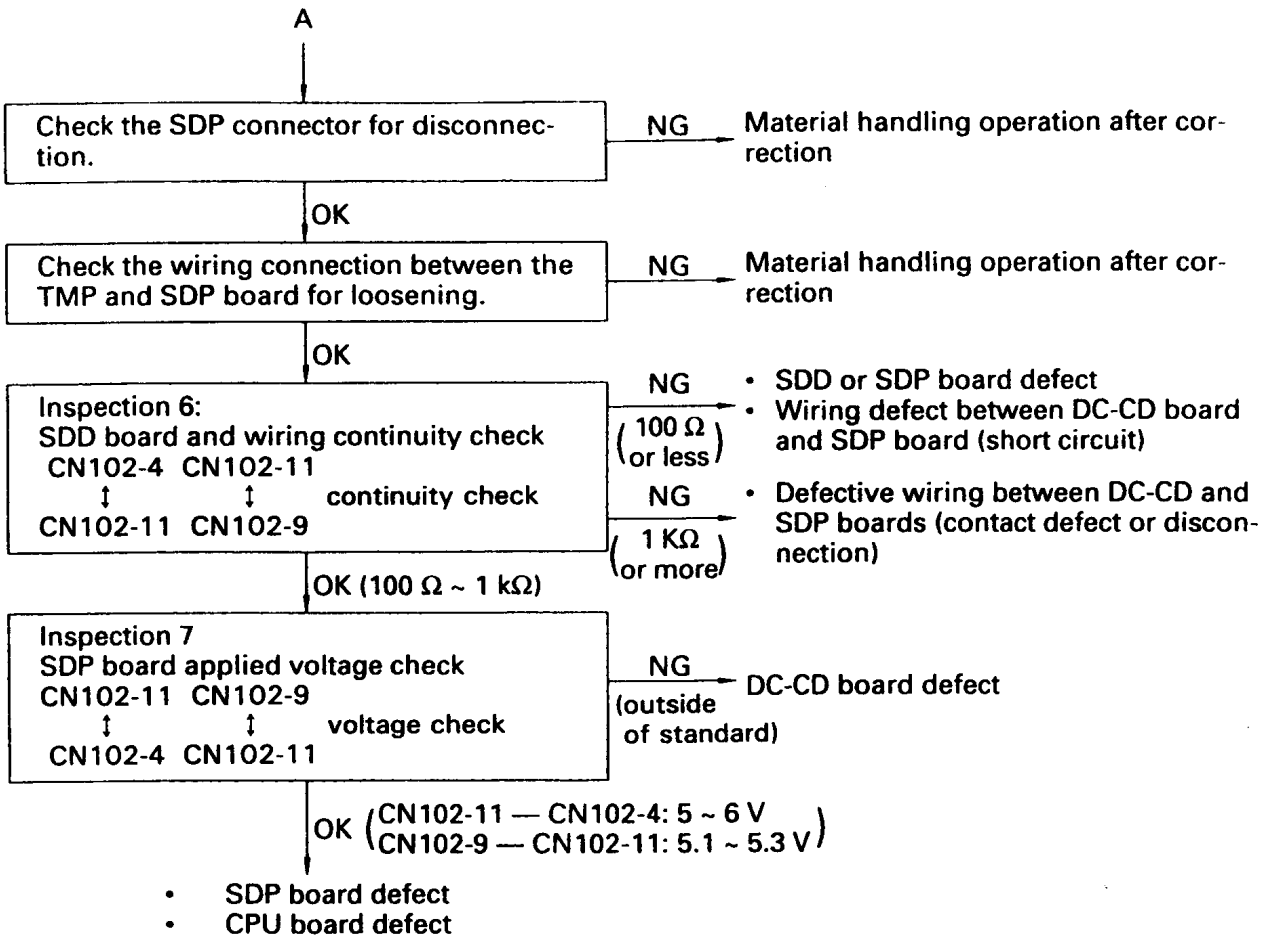
⑤ Defective contact of each connector (CPU, DC-CD and SDP boards)

⑥ SDD or SDP board defect

⑦ DC-CD board defect

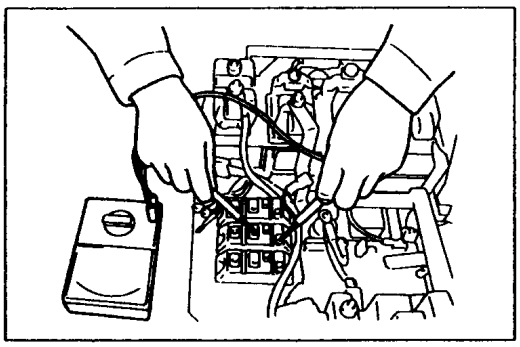
⑧ CPU board defect


Does the pump motor rotate when the battery plug is ON and the key switch is turned ON?
NO
To A on next page
YES
Inspection 1:
TMP individual check
OK
(standard)
• SDP board defect
• CPU board defect
(outside of standard)
NG
Inspection 2:
DF3 individual check
NG
(outside of standard)
DF3 defect
(forward: approx. 6 kΩ
reverse: ∞ Ω
OK
Replacement
Inspection 3:
DAP individual check
NG
(outside of standard)
DAP defect
(forward: approx. 6 kΩ
reverse: ∞ Ω
OK
Replacement
Inspection 4:
CAP individual check
NG
(outside of standard)
CAP defect
OK
(within standard)
Replacement
Inspection 5:
RAP individual check
NG
(∞ Ω)
RAP defect
OK (approx. 25 Ω)
Replacement
TMP defect


A
Check the SDP connector for disconnection.
NG
Material handling operation after correction
OK
Check the wiring connection between the TMP and SDP board for loosening.
NG
Material handling operation after correction
OK
Inspection 6:
SDD board and wiring continuity check
CN102-4 CN102-11
↕ ↕ continuity check
CN102-11 CN102-9
NG (100 Ω or less)
• SDD or SDP board defect
• Wiring defect between DC-CD board and SDP board (short circuit)
NG (1 KΩ or more)
• Defective wiring between DC-CD and SDP boards (contact defect or disconnection)
OK (100 Ω ~ 1 kΩ)
Inspection 7
SDP board applied voltage check
CN102-11 CN102-9
↕ ↕ voltage check
CN102-4 CN102-11
NG (outside of standard)
DC-CD board defect
OK (CN102-11 — CN102-4: 5 ~ 6 V
CN102-9 — CN102-11: 5.1 ~ 5.3 V)
• SDP board defect
• CPU board defect

Inspection 1: TMP individual check
Battery plug OFF, TMP wiring and copper bar disconnection

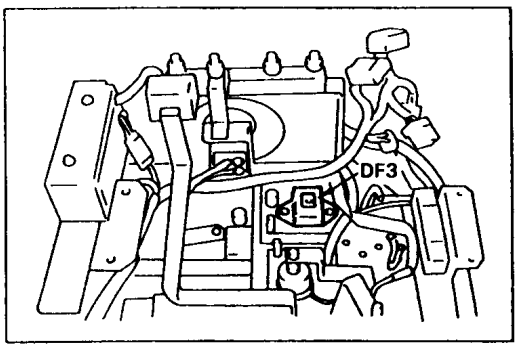
Measurement terminals	Between D and S	D ⊖ — S ⊕ D ⊕ — S ⊖
	Between D and G	D ⊖ — G ⊕ D ⊕ — G ⊖
	Between G and S	G ⊖ — S ⊕ G ⊕ — S ⊖
Circuit tester range	Ω × 1 k	
Standard	Between D and S	D ⊖ — S ⊕ : ∞ Ω D ⊕ — S ⊖ : ∞ Ω
	Between D and G	D ⊖ — G ⊕ : ∞ Ω D ⊕ — G ⊖ : continuity shall exist.
	Between G and S	G ⊖ — S ⊕ : continuity shall exist. G ⊕ — S ⊖ : ∞ Ω

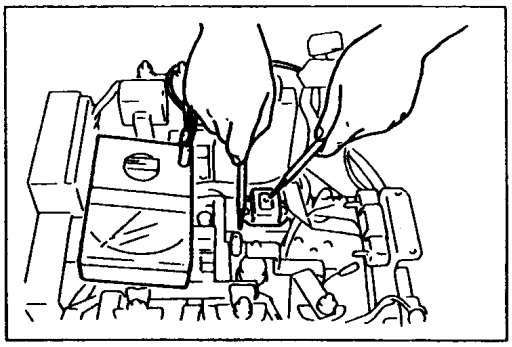


OK (standard) → SDP board defect, CPU board defect
NG (outside of standard) → To inspection 2

Inspection 2: DF3 individual check
Battery plug OFF, DF3 wiring disconnection

Measurement terminals	Forward: anode ⊖ – cathode ⊕ Reverse: anode ⊕ – cathode ⊖
Circuit tester range	Ω × 1 k
Standard	Forward: approx. 6 kΩ Reverse: ∞ Ω

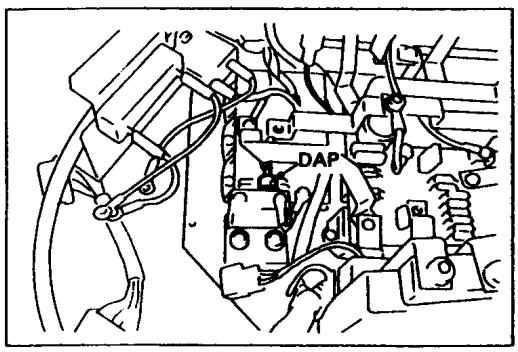


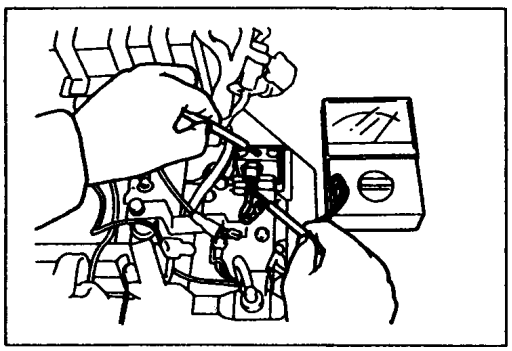


OK (within standard) → To inspection 3
NG (outside of standard) → DF3 defect (to inspection 3 after replacement)

Inspection 3: DAP individual check
Battery plug OFF, DAP wiring disconnection

Measurement terminals	Forward: anode ⊖ – cathode ⊕ Reverse: anode ⊕ – cathode ⊖
Circuit tester range	Ω × 1 k
Standard	Forward: approx. 6 kΩ Reverse: ∞ Ω

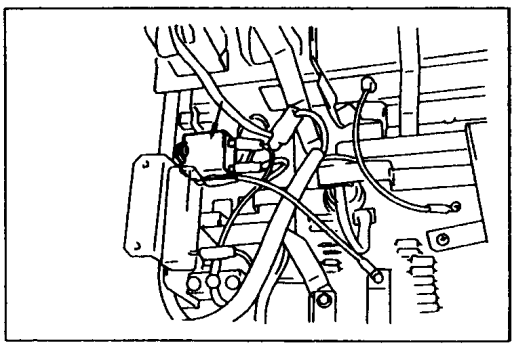


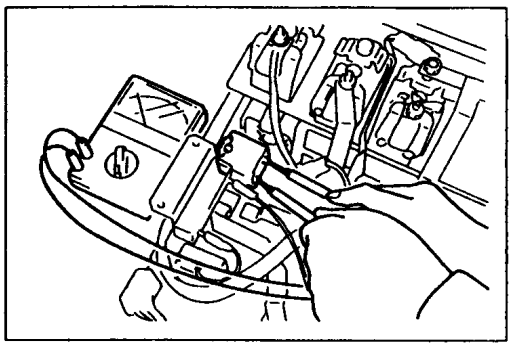


OK (forward: approx. 6 kΩ, reverse: ∞ Ω) → To inspection 4
NG (outside of standard) → DAP defect (to inspection 4 after replacement)

Inspection 4: CAP individual check
Battery plug OFF, CAP wiring disconnection

Measurement terminals	Both terminals of CAP
Circuit tester range	Ω × 1 k
Standard	Bring the tester probes into contact with both terminals of CAP. The indicator deflect once toward the 0 Ω side, returns gradually toward the ∞ Ω side, and finally indicates ∞ ohm. This is because the capacitor is charged by the circuit tester current.

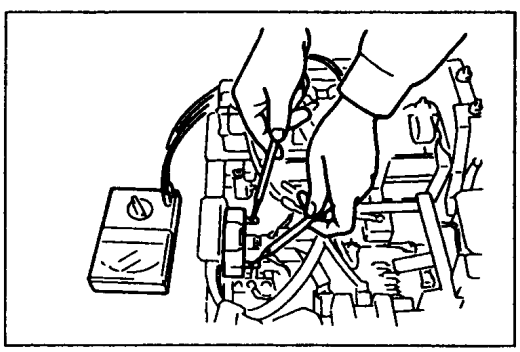




OK (within standard) → To inspection 5
NG (outside of standard) → CAP defect (to inspection 5 after replacement)

Inspection 5: RAP individual check
Battery plug OFF, RAP wiring disconnection

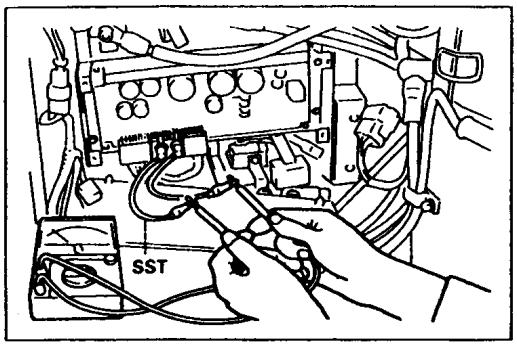
Measurement terminals	Both terminals of RAP
Circuit tester range	Ω × 100
Standard	Approx. 25 Ω

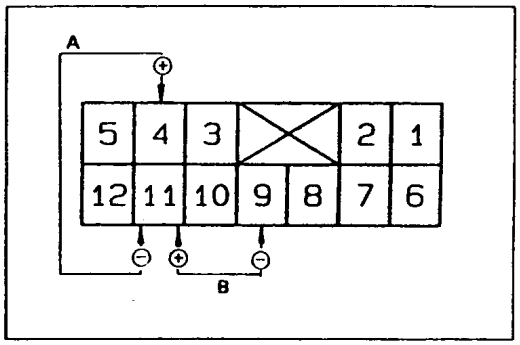


OK (approx. 25 Ω) → TMP defect
NG (∞ Ω) → RAP defect (Inspect the TMP after replacement, and replace the TMP if defective.)

Inspection 6: SDD board and wiring continuity check (using an analog tester)
Battery plug OFF, SW_{KV} OFF

Measurement terminals	A: CN102-4 (12) ⊕ — CN102-11 (11) ⊖ B: CN102-11 (11) ⊕ — CN102-9 (10) ⊖
Circuit tester range	Ω × 1k
Standard	100 Ω ~ 1 kΩ

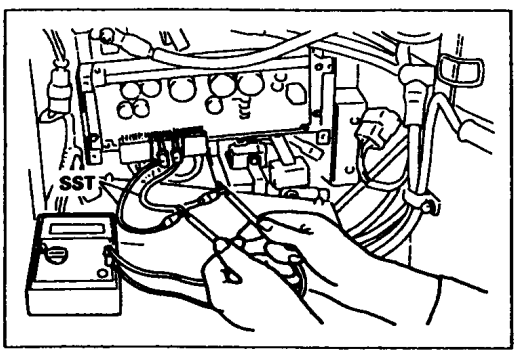


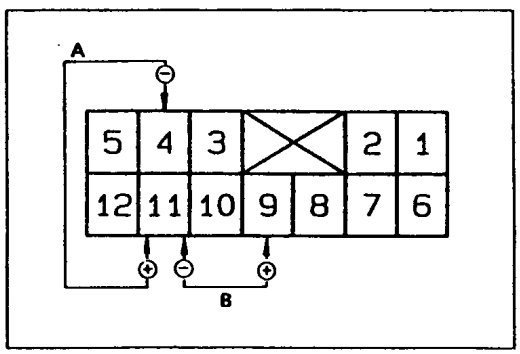


OK (100 Ω ~ 1 k Ω) → To inspection 7
NG (100 Ω less) → SDD or SDP board defect, DC-CD board - SD board wiring defect (short circuit)
NG (1 k Ω more) → DC-CD board - SD board wiring defect (contact defect or disconnection)

Inspection 7: SDP board applied voltage check (using a digital tester)
Battery plug ON, SW_{KV} ON

Measurement terminals	A: CN102-11 (11) ⊕ — CN102-4 (12) ⊖ B: CN102-9 (10) ⊕ — CN102-11 (11) ⊖
Circuit tester range	DC 10 V
Standard	CN102-11 ⊕ — CN102-4 ⊖ : 5 ~ 6V CN102-9 ⊕ — CN102-11 ⊖ : 5.1 ~ 5.3 V

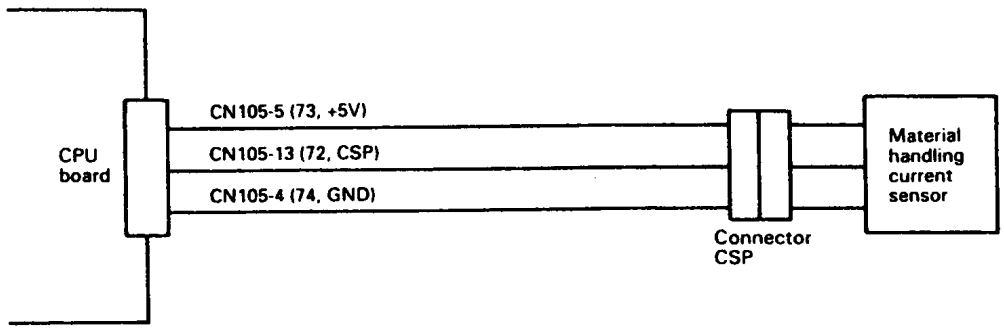




OK (within standard) → SDP board defect, CPU board defect
NG (outside of standard) → DC-CD board defect

ERROR CODE E1: MAIN MATERIAL HANDLING CIRCUIT CURRENT SENSOR ABNORMALITY

Related portion



Estimated causes

① Material handling current sensor defect

② Defective contact between CN105 and connector CSP

③ TMP short circuit

④ CPU board defect

Are E0 and E1 displayed alternately?

YES (E0 and E1 are displayed) → To action for E0

NO (only E1 error)

Inspection 1
CSP output voltage check
CN105-13
↕voltage check
CN105-4

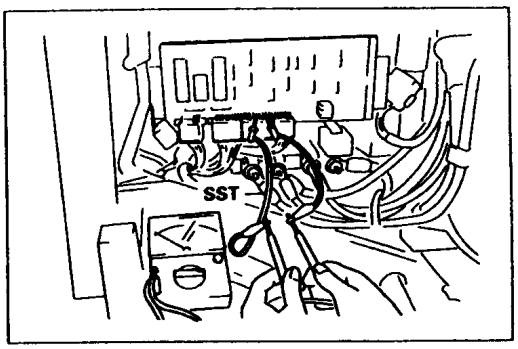
NG (1.0 V or more)
- CSP defect
- Wiring defect

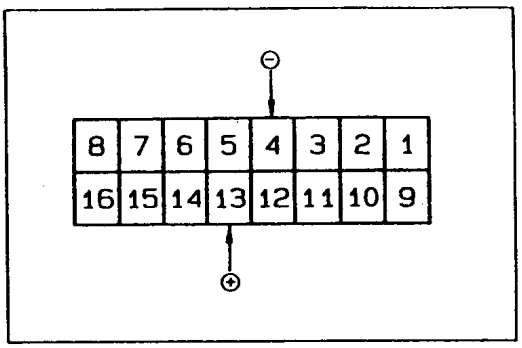
OK (approx. 0.2 V)

CPU board defect

Inspection 1. CSP output voltage measurement
Battery plug ON, SW_{KV} ON

Measurement terminals	CN105-13 (72) ⊕ – CN105-4 (74) ⊖
Circuit tester range	DC 10 V
Standard	Approx. 0.2V

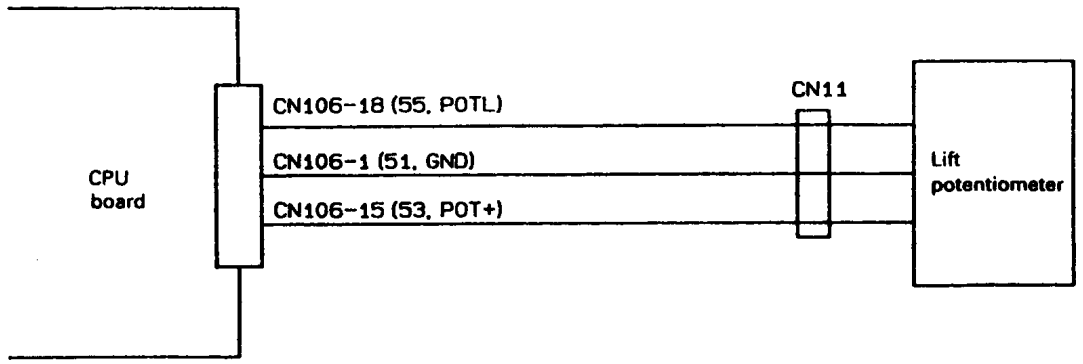




OK (approx. 0.2V) → CPU board defect
NG (1.0 V or more) → CSP defect, wiring defect

ERROR CODE E6: LIFT POTENTIOMETER ABNORMALITY

Related portion



Estimated causes

① Lift potentiometer defect

② Lift potentiometer wiring open

③ CPU board defect

ANL12: Test operation (No.7)
Check the lift potentiometer.
See page 5-21.

NG (0 V or 4.1 V or more) → Lift potentiometer defect

OK (more than 0 V and less than 4.1 V)

Check any short circuit between CN106-15 and CN106-18.

NG → Wiring correction

OK

Check disconnection in CN106-18 wiring.

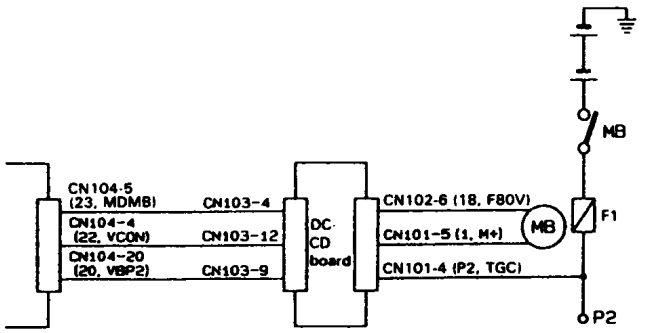
NG → Wiring correction

OK

CPU board defect

ERROR CODE EA: MB CONTACTOR ABNORMALITY

Related portion



Estimated causes

① MB contactor welding

② CPU board defect

③ DC-CD board defect

MB contactor state with the key switch at OFF

NG (ON) → Check the MB contactor state (not welded?)

NG (welded) → MB contactor correction

OK (not welded)
- DC-CD board defect
- CPU board defect

OK (OFF)

Inspection 1
P1A
↕ Voltage check with the key switch at OFF
N1

NG (battery voltage) → Defect of wiring to P1A (short circuit with battery ⊕)

OK (0 V)

ANL11: ESY22
Contactor ON/OFF check
See page 5-19.

NO (other than conditions for Yes) → Inspection 2
SW_{KY} ON
CN104-6
↕ voltage check
CN104-22

NG (0 V) → CPU board defect

OK (approx. 5 V)
- Harness defect
- Contactor coil open
- DC-CD board defect

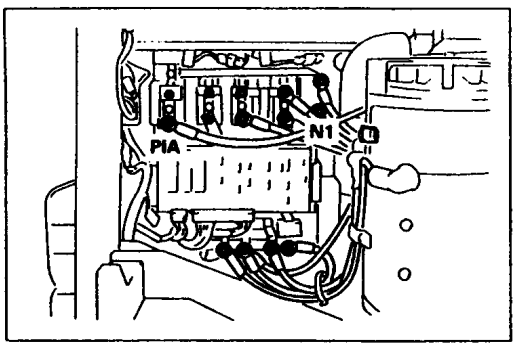
Conditions for Yes
- Contactor closed and "H" display for short circuit
- Contactor not closed and "H" display for open circuit

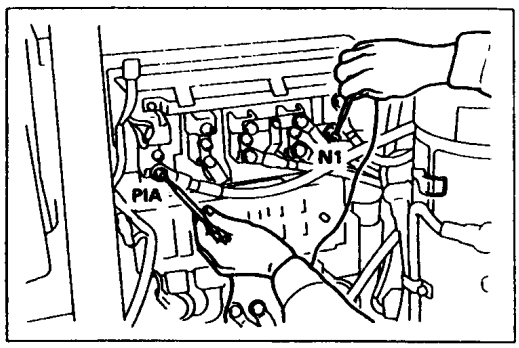
YES

DC-CD board defect

Inspection 1. P1A terminal voltage measurement
Battery plug ON, SW_{KY} ON

Measurement terminals	P1A ⊕ – N1
Circuit tester range	DC 250 V
Standard	0 V

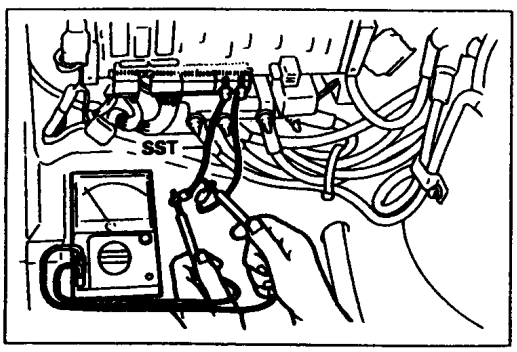


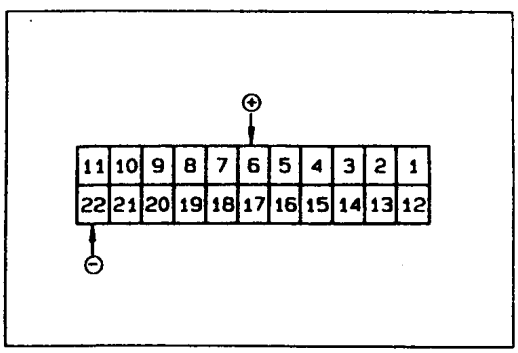


OK (0 V) → ANL11: ESY-22
NG (battery voltage) → Defect of wiring to P1A (short circuit with battery ⊕)

Inspection 2. MB contactor signal voltage check
Battery plug ON, SW_{KY} ON

Measurement terminals	CN104-6 (23) ⊕ – CN104-22 (N2) ⊖
Circuit tester range	DC 10 V
Standard	Approx. 5 V





OK (approx. 5 V) → Harness defect, Contactor coil open, DC-CD board defect
NG (0 V) → CPU board defect

ERROR CODE EC:MATERIAL HANDLING CIRCUIT OCL VALUE ABNORMAL DROP

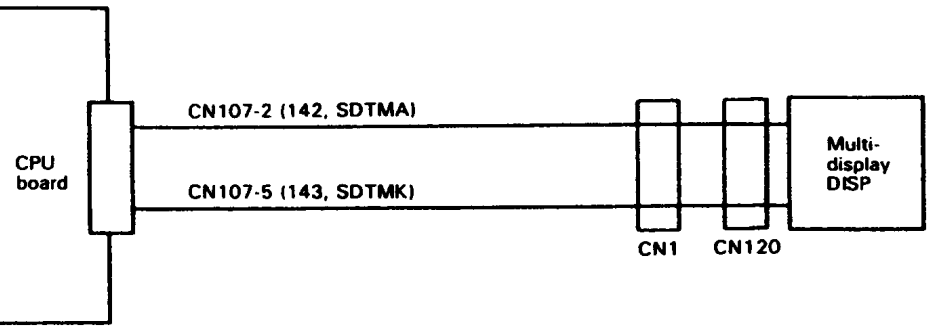
Estimated causes

① CPU board defect

Replace the CPU board when EC is displayed.

ERROR CODE EE:MCS RECEIVING DATA ABNORMALITY

Related portion



Estimated causes

① Multi-display defect

② CN107 • CN1 • CN120 contact defect

③ Disconnection of wiring between CN107 and multi-display

④ CPU board defect

CN107 disconnection check, wiring disconnection check and display side connector check → NG → Display check after correction

↓ OK

- CPU board defect
- Multi-display board defect
  (replace the CPU board first)

ERROR CODE EF:CPU PROCESSING TIME ABNORMALITY

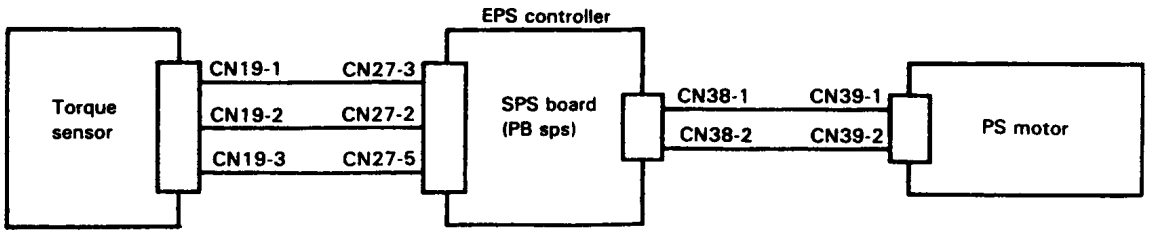
Estimated causes

① CPU board defect

Replace the CPU board when EF is displayed.

ERROR CODE F0:POWER STEERING ELEMENT ABNORMALITY

Related portion



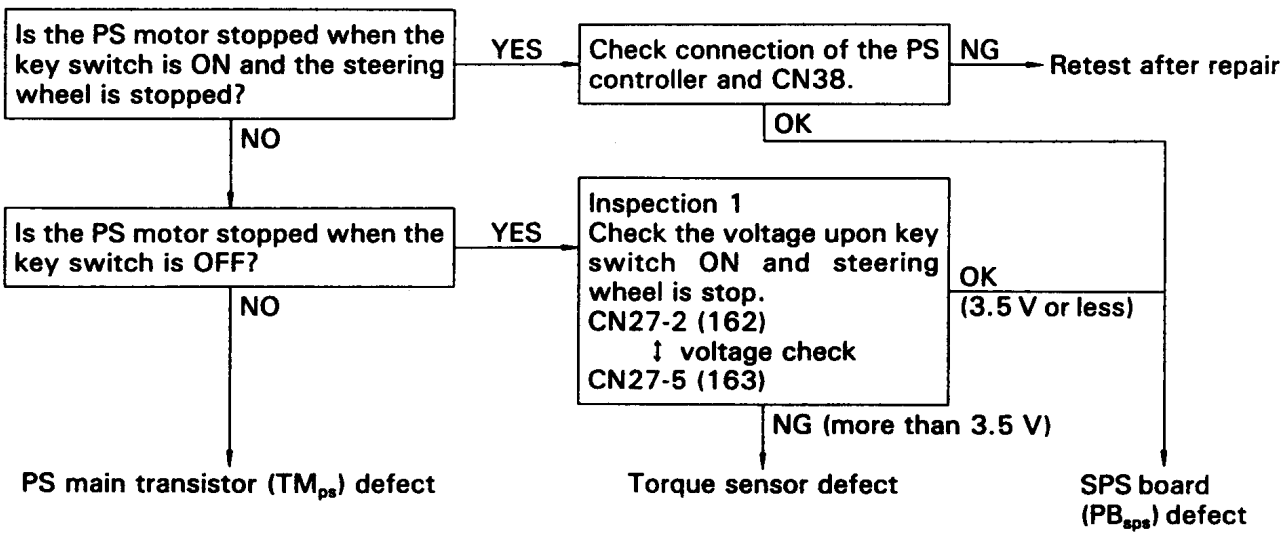
Estimated causes

① PS main transistor (TM_{ps}) defect

② Torque sensor defect

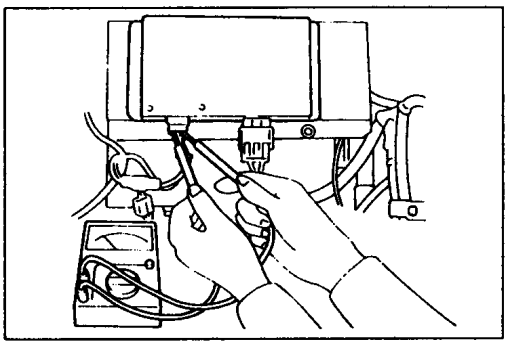
③ SPS board (PB_{sps}) defect

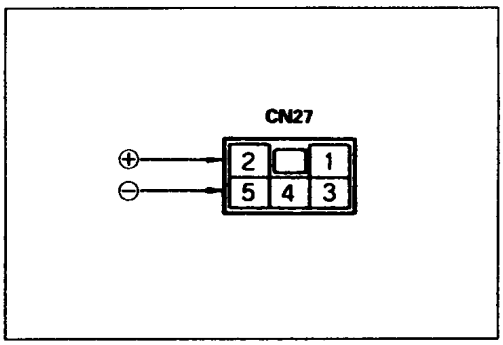
④ Wiring harness and connector defect



Inspection 1. ST voltage check
Battery plug ON, SW_{KY} ON, steering wheel not operated

Measurement terminals	CN27-2 (162, ST) ⊕ – CN27-5 (163, GND) ⊖
Circuit tester range	DC10 V
Standard	3.5 V or less





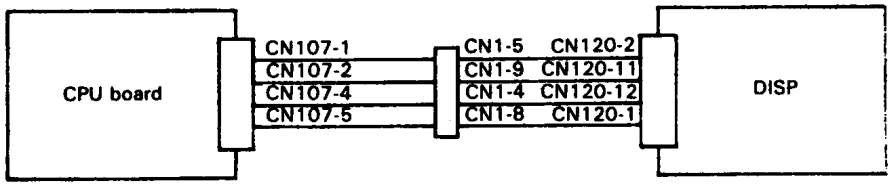
OK (3.5 V or less) → SPS board (PB_{sps}) defect
NG (more than 3.5 V) → Torque sensor defect

ERROR CODE F1:DISPLAY TO MCS COMMUNICATION FAILURE

ERROR CODE F2:DISPLAY TO MCS COMMUNICATION DATA ERROR

ERROR CODE F3:DISPLAY TO MCS COMMUNICATION DATA INVALID

Related portion



Estimated causes

① CPU board defect

② Multi-display board defect

③ Wiring harness or connector defect

Check connection of the CN107 and CN120. — NG → Retest after repair

OK ↓

- CPU board defect
- Multi-display board defect

ERROR CODE F4:POWER CONTROLLER MEMORY VALUE ABNORMALITY

Estimated causes

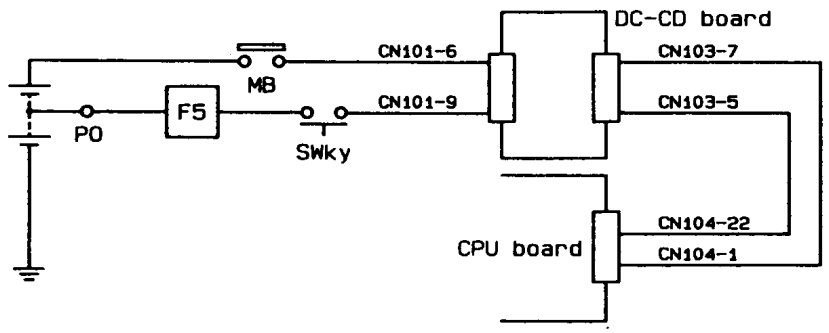
① Multi-display or CPU board defect

DIAGNOSTIC ERROR CODE IS NOT DISPLAYED

DRIVE SYSTEM

1. The vehicle does not move at all. (The multi-display is kept off even when the key switch is turned ON.)

Related portion



Estimated causes

① The battery voltage is not applied.

② The voltage after the key switch is not applied.

③ The DC-CD 30V power is not supplied.

Inspection 1
CN101-6 (P1A, MB80V)
↕ voltage check
CN101-7 (N2, GND)

NG (0 V)
- Battery connector defect
- MB contactor defect
- Internal open circuit in battery

OK (battery voltage)

Inspection 2
CN101-9 (43, K48V)
↕ voltage check
CN101-7 (N2, GND)

NG (0 V)
- Key switch defect
- Wiring defect

OK (battery voltage)

Inspection 3
CN104-1 (15, +30V)
↕ voltage check
CN104-22 (N2, GND)

NG (0V) → To A on next page

OK (approx. 25V)

CPU board defect

A

Inspection 4
Disconnect CN107
CN104-1 (15, +30 V)
↕ voltage check
CN104-22 (N2, GND)

NG (0 V) → Inspection 5
Disconnect CN104
CN104-1 (15, +30 V)
↕ voltage check
CN104-22 (N2, GND)

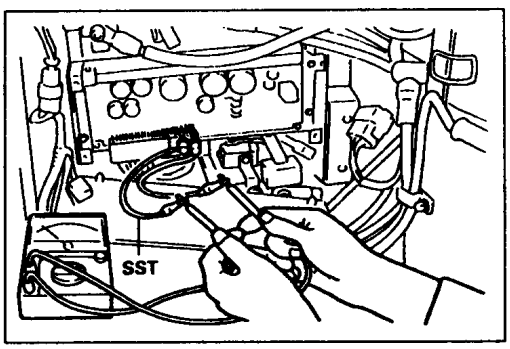
NG (0 V) →
- CD-DC board defect
- Defective wiring (short circuit) between CN101 and CN104

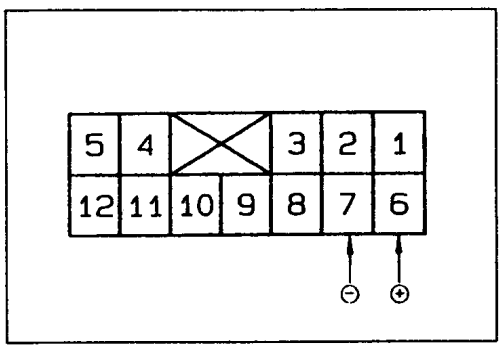
OK (approx. 25 V) →
- Display defect
- Defective wiring (short circuit) between CN107 and display
- CPU board defect

OK (approx. 25 V) → CPU board defect

Inspection 1: Battery voltage measurement
Battery plug ON, SWky ON

Measurement terminals	CN101-6 (P1A) ⊕ – CN101-7 (N2) ⊖
Circuit tester range	DC 250 V
Standard	Battery voltage

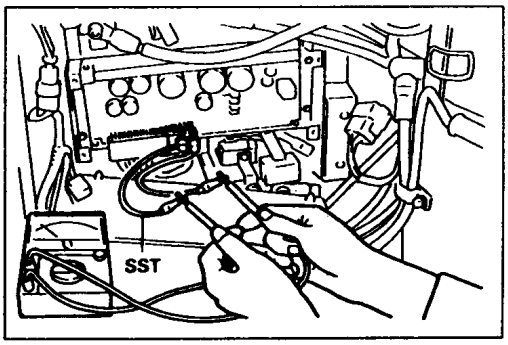


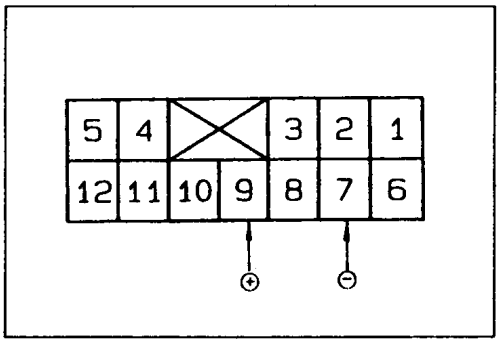


OK (battery voltage) → To inspection 2
NG (0 V) → Battery connector defect, blown F5 fuse, Internal open circuit in battery

Inspection 2. Voltage measurement after SW_{KY}
Battery plug ON, SW_{KY} ON

Measurement terminals	CN101-9 (43) ⊕ – CN101-7 (N2) ⊖
Circuit tester range	DC 250 V
Standard	Battery voltage

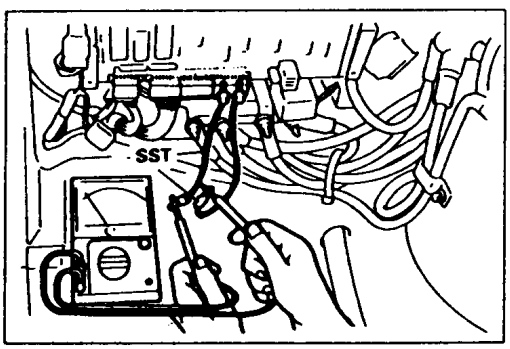


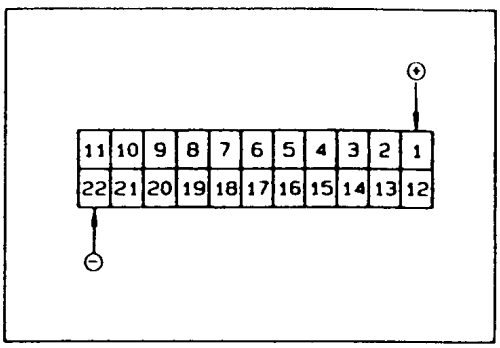


OK (battery voltage) → To inspection 3
NG (0 V) → SW_{KY} defect, wiring defect

Inspection 3. DC-CD supply voltage measurement
Battery plug ON, SW_{KY} ON

Measurement terminals	CN104-1 (15) ⊕ – CN104-22 (N2) ⊖
Circuit tester range	DC 50 V
Standard	Approx. 25 V

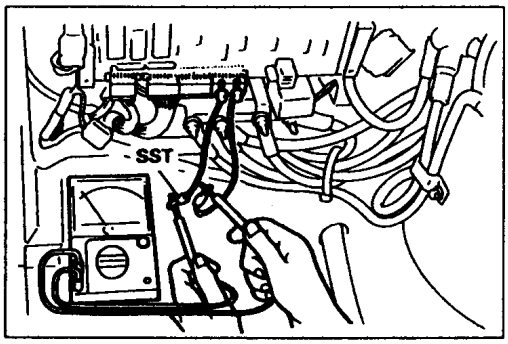


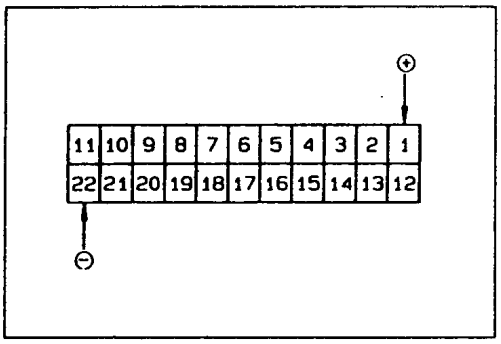


OK (approx. 25 V) → CPU board defect
NG (0 V) → To inspection 4

Inspection 4. DC-CD supply voltage measurement
Battery plug ON, SW_{KY} ON, CN107 connector disconnection

Measurement terminals	CN104-1 (15) ⊕ – CN104-22 (N2) ⊖
Circuit tester range	DC 50 V
Standard	Approx. 25 V

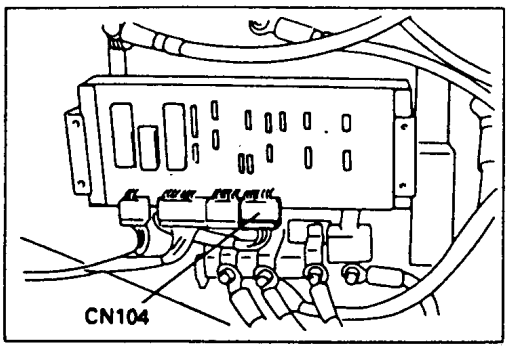


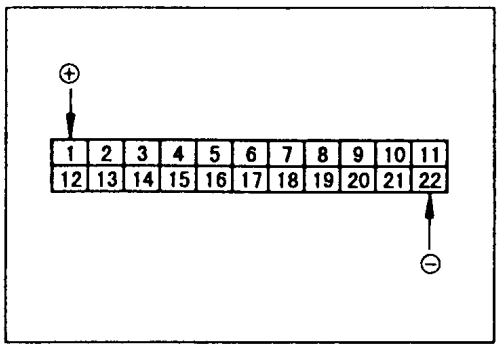


OK (approx. 25 V) → Display defect, Defective wiring (short circuit) between CN107 and display, CPU board defect
NG (0 V) → To inspection 5

Inspection 5. DC-CD supply voltage measurement
Battery plug ON, SW_{KY} ON, CN104 CPU board side connector disconnection

Measurement terminals	CN104-1 (15) ⊕ (REC) - CN104-22 (N2) ⊖ (REC)
Circuit tester range	DC 50 V
Standard	Approx. 25 V

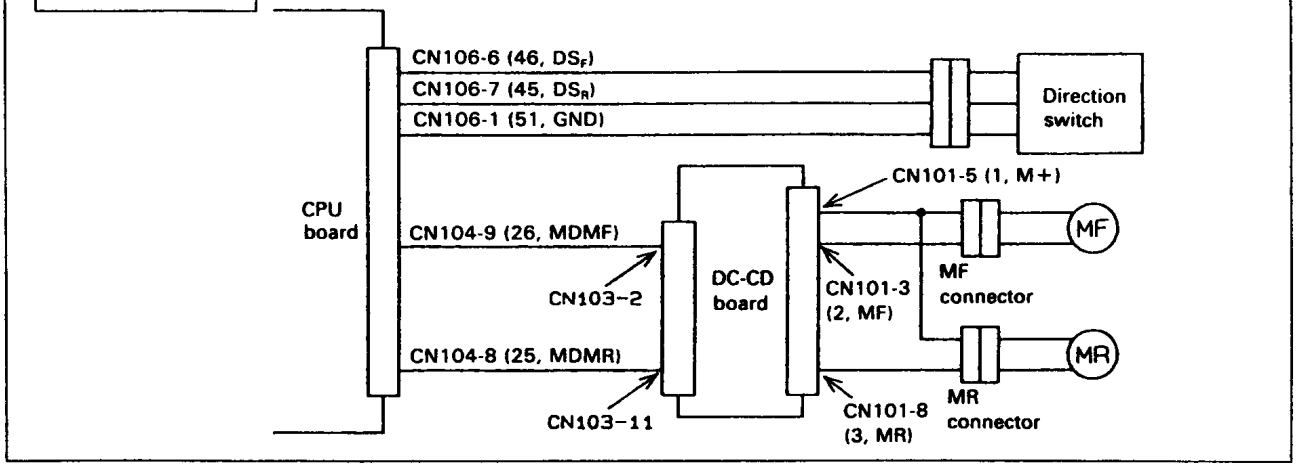




OK (approx. 25 V) → CPU board defect
NG (0 V) → DC-CD board defect, Defective wiring (short circuit) between CN101 and CN104

2. The vehicle does not move at all. (MF (MR) contactor not closed when the direction lever is set to forward (or reverse).)

Related portion



Estimated causes

① Battery overdischarge

② Direction switch signal input failure

③ MF•MR contactor coil disconnection

④ CPU board defect

⑤ Brake switch defect

Inspection 1
P2
↕ voltage check
N1

NG (less than 20V) → • Battery overdischarge

OK (20 V or more)

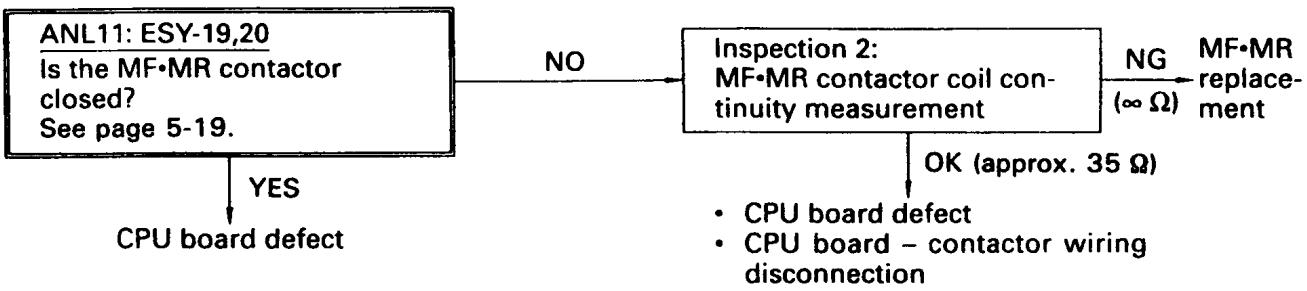
ANL31: Switch input test
Is the direction switch turned ON and OFF by the direction lever?
See page 5-25.

NO (not turned ON/OFF) →
• Direction switch defect
• DSF•DSR – CN106 wiring defect

YES (turned ON/OFF)

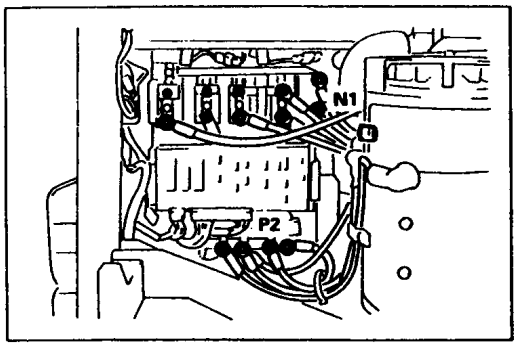
A

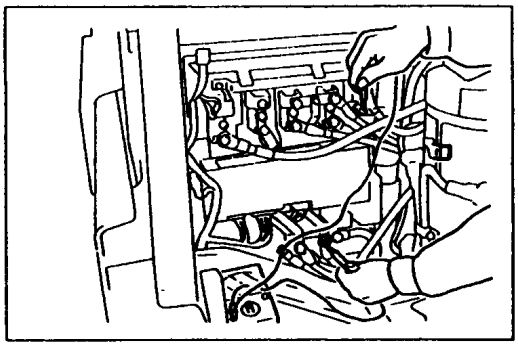
A


ANL11: ESY-19,20
Is the MF•MR contactor closed?
See page 5-19.
NO
Inspection 2:
MF•MR contactor coil continuity measurement
NG
(∞ Ω)
MF•MR replacement
YES
CPU board defect
OK (approx. 35 Ω)
• CPU board defect
• CPU board – contactor wiring disconnection

Inspection 1. Battery voltage measurement
Battery plug ON, SW_{KY} ON

Measurement terminals	P2 ⊕ - N1 ⊖
Circuit tester range	DC 250 V
Standard	20 V or more

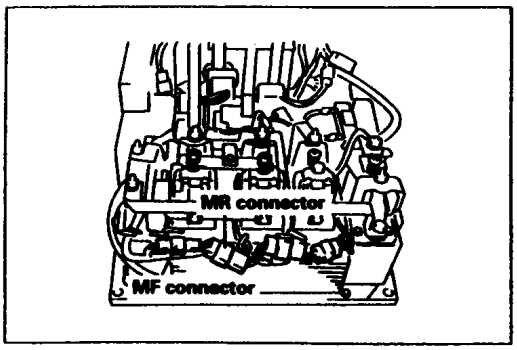


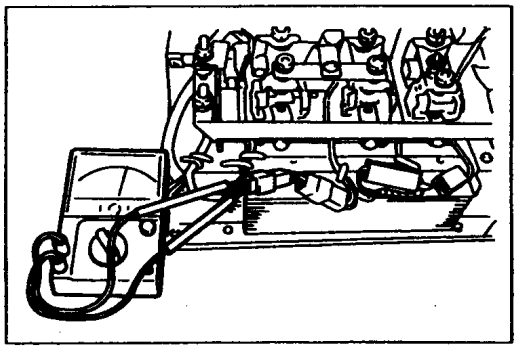


OK (20 V or more) → ANL31: switch input test
NG (less than 20 V) → Battery overdischarge

Inspection 2. MF • MR contactor coil continuity check
Battery plug OFF, and MF·MR connector disconnection

Measurement terminals	Both terminals of MF • MR connector
Circuit tester range	Ω × 1
Standard	Approx. 35 Ω (at 20°C (68°F))

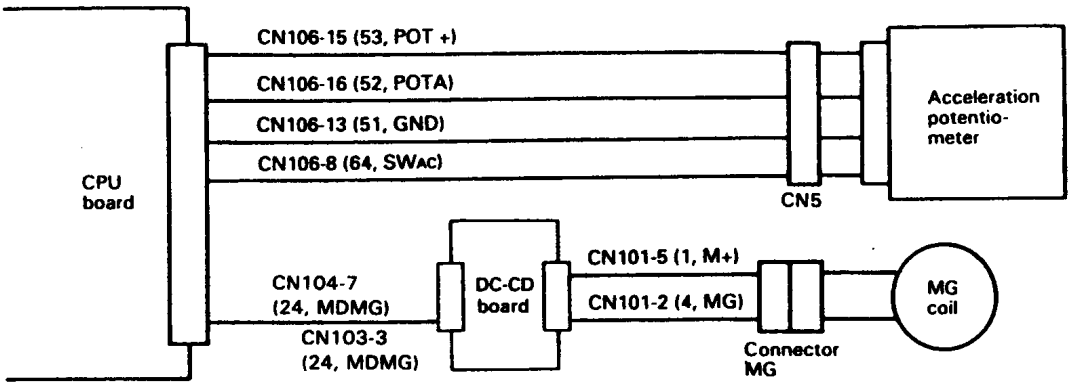




OK (approx. 35 Ω) → CPU board defect, wiring disconnection (between CPU board and MF·MR contactor)
NG (∞ Ω) → MF • MR contactor replacement

3. The vehicle does not move at all. (The MF•MR contactor is closed when the accelerator pedal is depressed, but the MG contactor is not closed.)

Related portion



Estimated causes

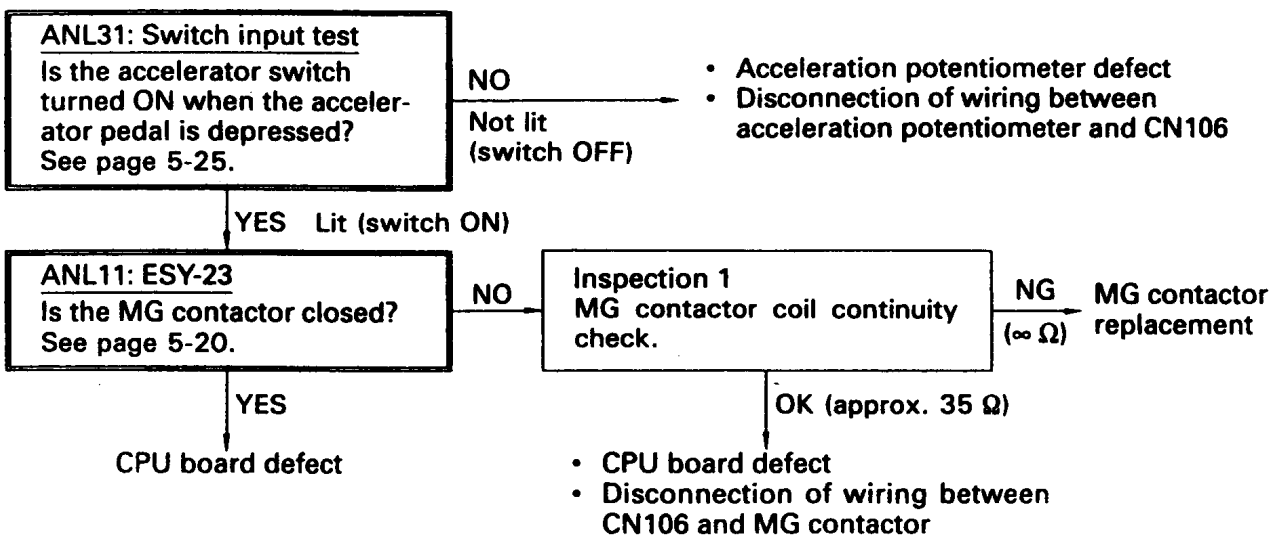
① The accelerator switch signal is not input.

② CPU board defect

③ Acceleration potentiometer defect

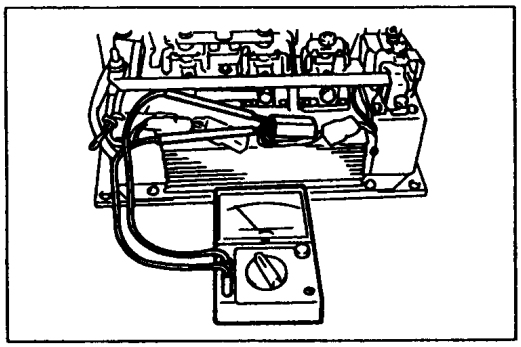
④ MG contactor defect

⑤ Wiring disconnection



Inspection 1. MG contactor coil continuity check
Battery plug OFF, MG connector disconnection

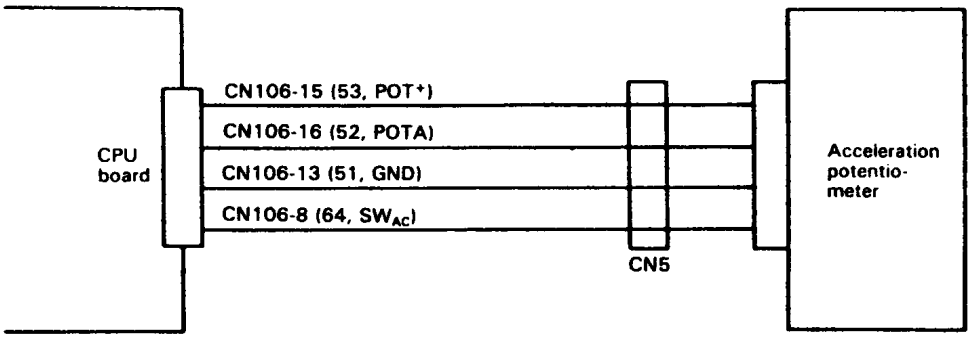
Measurement terminals	Both terminals of MG connector
Circuit tester range	Ω × 1
Standard	Approx. 35 Ω (at 20°C (68°F))



OK (approx. 35 Ω) → CPU board defect, disconnection of wiring (between CPU board and MG contactor)
NG (∞ Ω) → MG contactor replacement

4. The vehicle does not move at all. (The MG-MF and MR contactors are closed.)

Related portion



Estimated causes

① The acceleration potentiometer signal is not input.

② CPU board defect

③ Motor circuit abnormality

ANL12: Test operation(No.5)
Acceleration potentiometer voltage check
See page 5-21.

NG →
- Acceleration potentiometer defect
- Disconnection of wiring between acceleration potentiometer and CN106
- "P" mark does not appear when the accelerator pedal is depressed.
- The value does not change when the accelerator pedal is depressed.

OK
- "P" mark appears when the accelerator pedal is depressed.
- The value changes when the accelerator pedal is depressed.

Inspection 1
Disconnect wiring of P4, P5, P6 and P7.
P4 ↕ P5, P6 ↕ P7 continuity check

NG (∞ Ω) →
- Open circuit in armature coil
- Open circuit in field coil

* OK (approx. 0 Ω)

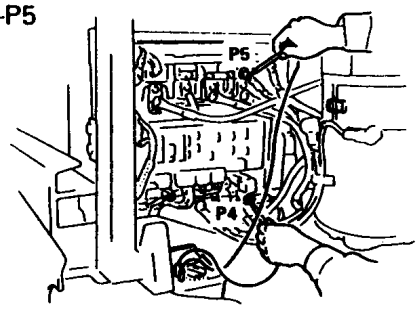
CPU board defect

* **Approx. 0 Ω is the motor coil resistance very close to 0 Ω.**

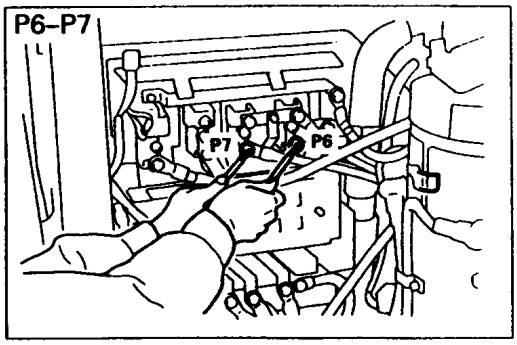
Inspection 1. Drive motor continuity check
Battery plug OFF, cable disconnection from P4 to P7

Measurement terminals	Armature coil: P4 – P5 Field coil: P6 – P7
Circuit tester range	Ω × 1
Standard	Approx. 0 Ω

P4–P5



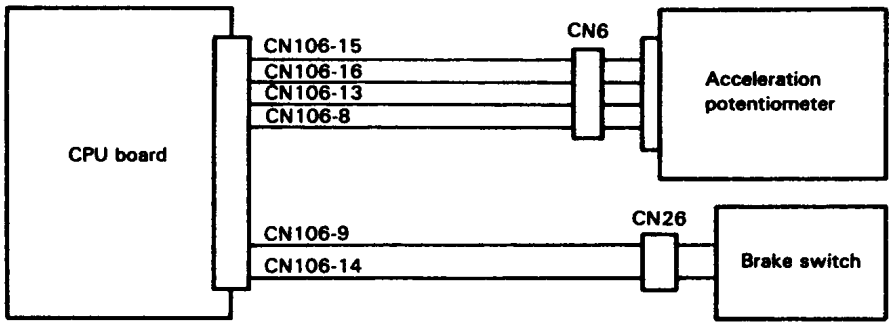
P6–P7



OK (approx. 0 Ω) → CPU board defect
NG (∞ Ω) → Open circuit in armature coil or field coil

5. Normal speed control fails. (No acceleration)

Related portion



Estimated causes

① Insufficient acceleration potentiometer signal

② Drive OCL value drop

③ Brake switch defect

ANL12: Test operation(No.5)
Acceleration potentiometer voltage check
See page 5-21.

NG → • Acceleration potentiometer defect
• Wiring defect
(Acceleration potentiometer ~ CN106)

The acceleration voltage difference is less than 1.4 V. (See page 5-18)

OK
The acceleration voltage difference is 1.4 V or more. (See page 5-18)

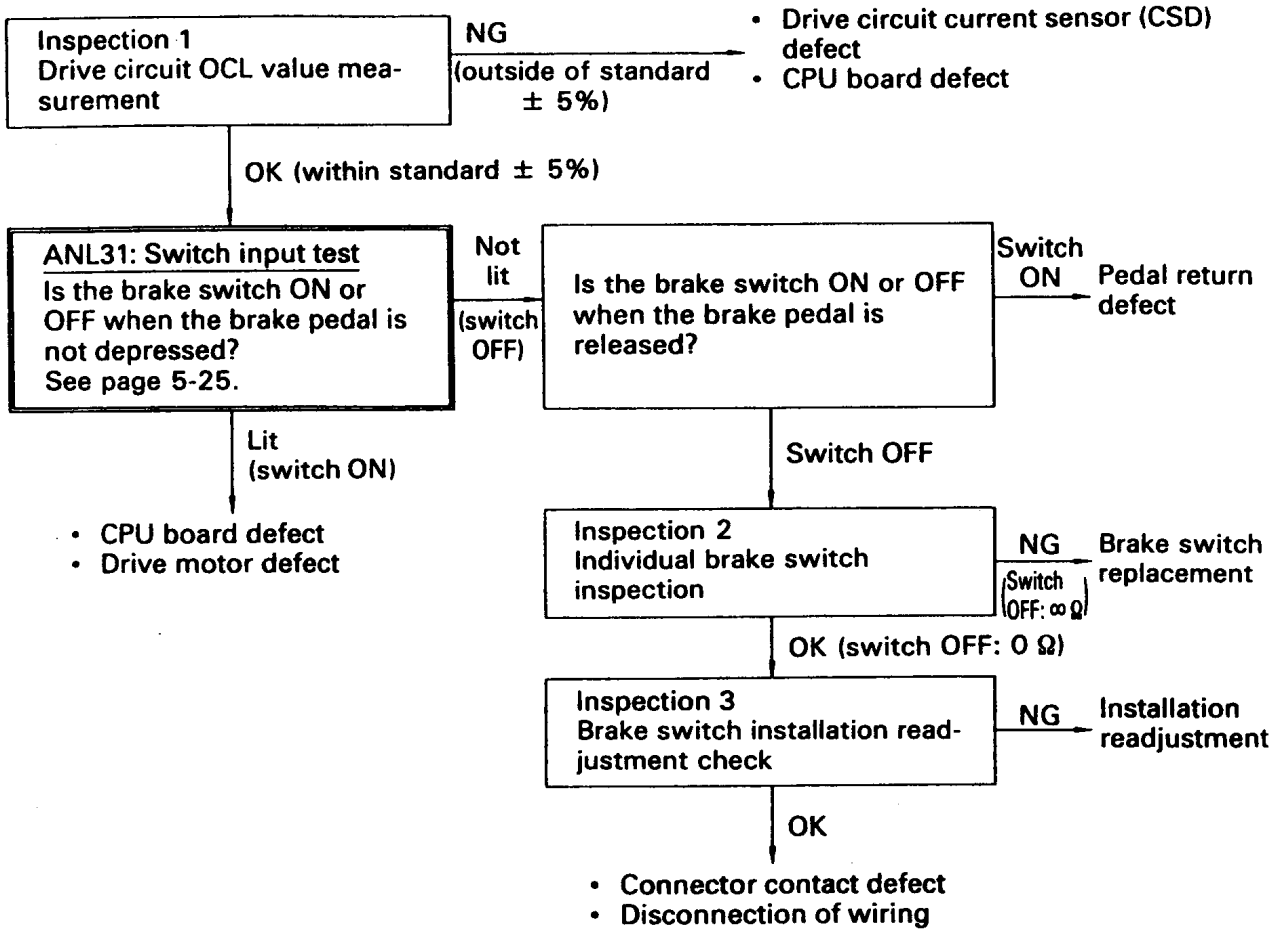
ANL31: Switch input test
Check the brake switch operation.
See page 5-25.
CN106-9 (65)
↕ voltage check
CN106-1 (51)

NG (2 V or more at switch ON) → • Brake switch defect
• Harness (brake switch ~ CN106) defect

OK
(0.8 V or less at switch OFF)

To A on next page

A

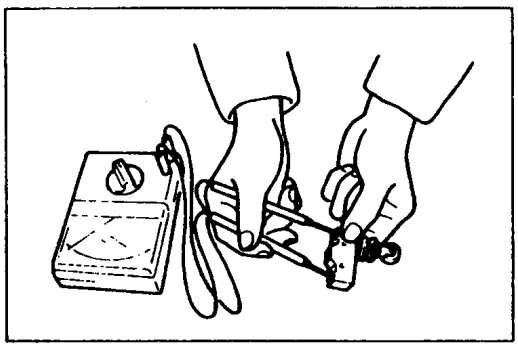

Inspection 1
Drive circuit OCL value measurement
NG
(outside of standard ± 5%)
• Drive circuit current sensor (CSD) defect
• CPU board defect
OK (within standard ± 5%)
ANL31: Switch input test
Is the brake switch ON or OFF when the brake pedal is not depressed?
See page 5-25.
Not lit
(switch OFF)
Is the brake switch ON or OFF when the brake pedal is released?
Switch ON
Pedal return defect
Lit
(switch ON)
Switch OFF
• CPU board defect
• Drive motor defect
Inspection 2
Individual brake switch inspection
NG
(Switch OFF: ∞ Ω)
Brake switch replacement
OK (switch OFF: 0 Ω)
Inspection 3
Brake switch installation readjustment check
NG
Installation readjustment
OK
• Connector contact defect
• Disconnection of wiring

Inspection 1. Drive circuit OCL value measurement
See the OCL value measurement (page 4-26) in the controller section.

OK (within standard ± 5%) → ANL31: switch input test
NG (outside of standard ± 5%) → CSD defect, CPU board defect

Inspection 2. Individual brake switch check
Battery plug OFF

Measurement terminals	Brake switch connector
Circuit tester range	Ω × 1
Standard	Switch OFF: 0 Ω

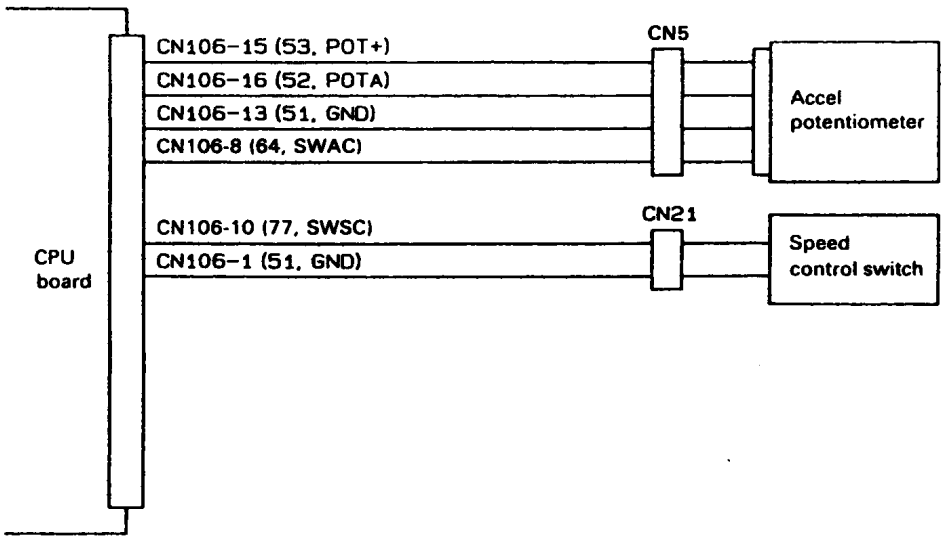


OK (switch OFF: 0 Ω) → To inspection 3
NG (switch OFF: ∞ Ω) → Brake switch replacement

Inspection 3. Brake switch installation adjustment check
See the brake switch adjustment (page 4-32) in the controller section.

6. The maximum speed is not attained.

Related portion



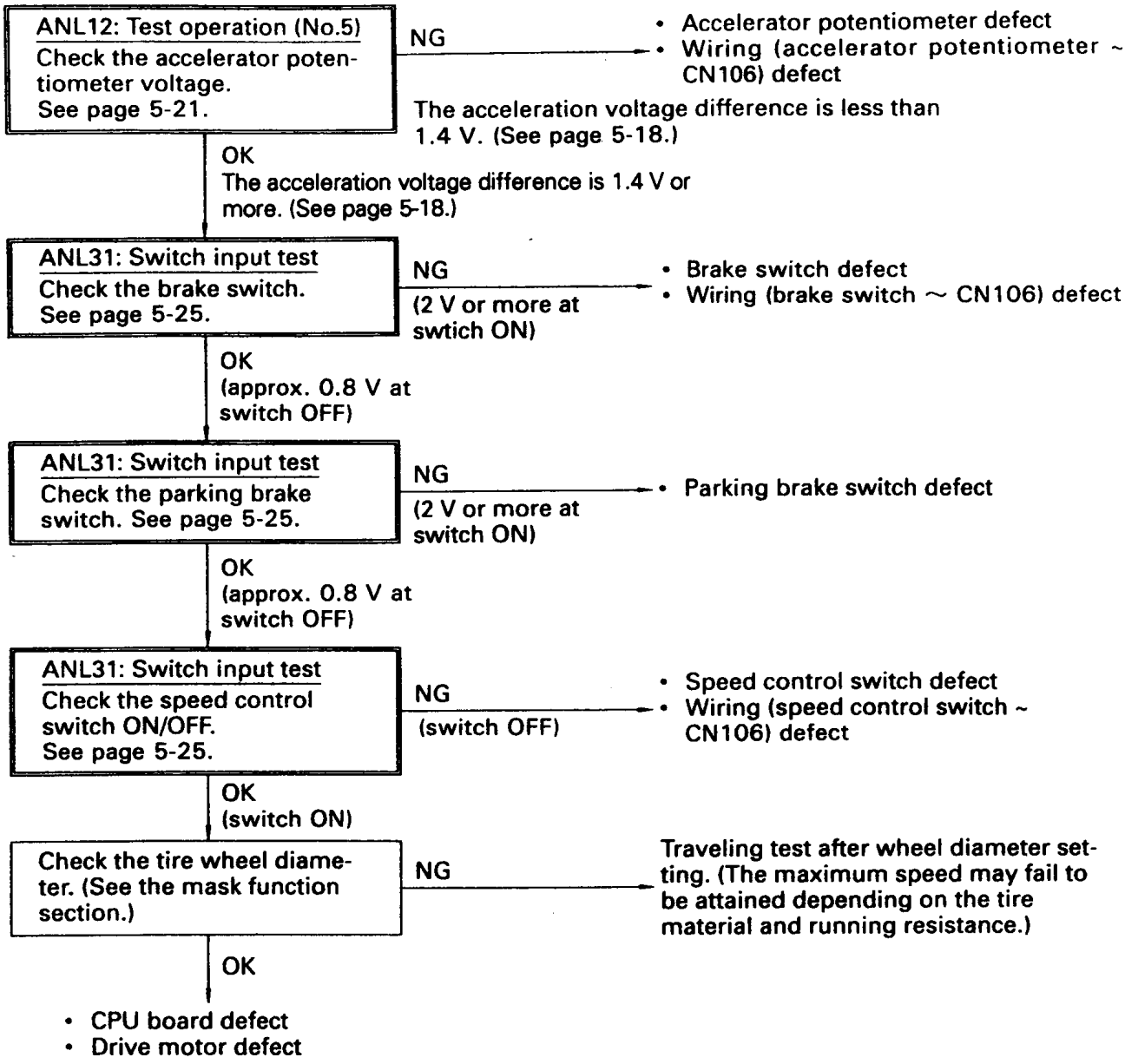
Estimated causes

① Insufficient acceleration potentiometer signal

② No speed control switch signal input

③ Wheel diameter setting error

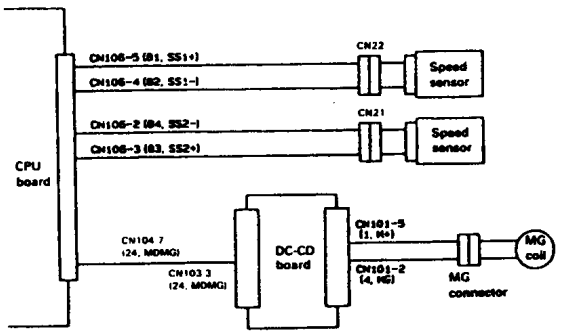
* The maximum speed is not attained when the speed control switch is ON or when the maximum speed limiter is set valid (display mask function tuning mode C5). (The tortoise mark is displayed in this state.)


ANL12: Test operation (No.5)
Check the accelerator potentiometer voltage.
See page 5-21.
NG
• Accelerator potentiometer defect
• Wiring (accelerator potentiometer ~ CN106) defect
The acceleration voltage difference is less than 1.4 V. (See page 5-18.)
OK
The acceleration voltage difference is 1.4 V or more. (See page 5-18.)
ANL31: Switch input test
Check the brake switch.
See page 5-25.
NG
(2 V or more at swtich ON)
• Brake switch defect
• Wiring (brake switch ~ CN106) defect
OK
(approx. 0.8 V at switch OFF)
ANL31: Switch input test
Check the parking brake switch. See page 5-25.
NG
(2 V or more at switch ON)
• Parking brake switch defect
OK
(approx. 0.8 V at switch OFF)
ANL31: Switch input test
Check the speed control switch ON/OFF.
See page 5-25.
NG
(switch OFF)
• Speed control switch defect
• Wiring (speed control switch ~ CN106) defect
OK
(switch ON)
Check the tire wheel diameter. (See the mask function section.)
NG
Traveling test after wheel diameter setting. (The maximum speed may fail to be attained depending on the tire material and running resistance.)
OK
• CPU board defect
• Drive motor defect

7. Regenerative braking is ineffective in switchback operation.

(1) Regenerative contactor (MG) is not opened just after switch back.

Related portion



Estimated causes

① Insufficient vehicle speed

② No speed sensor signal input

③ MG contactor welding (during traveling)

Traveling speed check
- NG (maximum speed is less than 5 km/h (3.1 mph)) → Check according to "6. The maximum speed is not attained."
- OK ↓

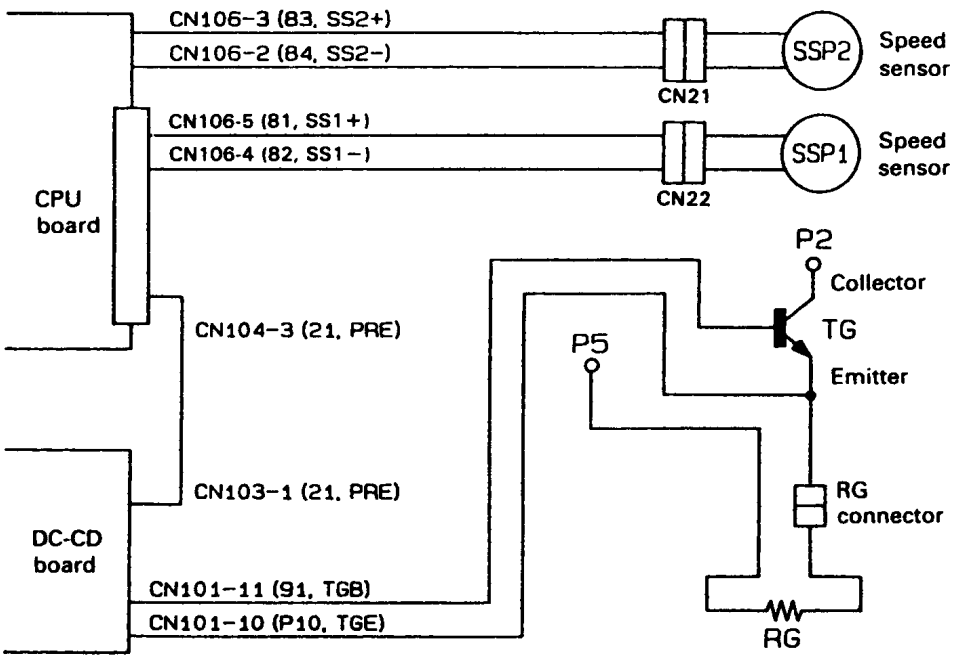
ANL13: Test operation (No.1)
Speed indication check
See page 5-23.
- NG → • Speed sensor defect • Wiring defect(speed sensor ~ CN106) (If NG still after checking and replacing the above, the CPU board should be judged defective.)
- OK ↓

ANL11: ESY-19
MG contactor operation check
See page 5-19.
- NG → • MG contactor defect • DC-CD board defect
- OK ↓

• CPU board defect

(2) Transition to plugging occurs soon. (The MG contactor are closed just after switch back.)

Related portion



Estimated causes

① Pre-excitation circuit defect

② Regeneration diode(DG) open

③ Speed sensor signal defect

Check wirings of the generation transistor (TG) and regeneration resistor (RG).

NG → Traveling test after correction

OK

Inspection 1
TG (emitter)
↕continuity check
P5

NG (outside of approx. 1.5 Ω) → To A on next page

OK (approx. 1.5 Ω)

To B on next page

A

Inspection 2
Disconnect RG connector and measure the resistance of regeneration resistor (RG).

NG (outside of approx. 1.5 Ω) → Regeneration resistor (RG) defect

OK (approx. 1.5 Ω)

Wiring disconnection (TG(E) ~ TG connector)

B

Inspection 3
Check the regeneration transistor (TG) after disconnecting wirings from its base and emitter.

NG (outside of standard) → Regeneration transistor (TG) defect

OK (standard)

Inspection 4
Check continuity from N1 to P4.

NG (∞ Ω)
- Regeneration diode (DG)open
- Loosened wiring or copper bar of regeneration diode(DG)

OK (3 kΩ)

ANL13: Test operation(No.1)
Speed indication check
See page 5-23

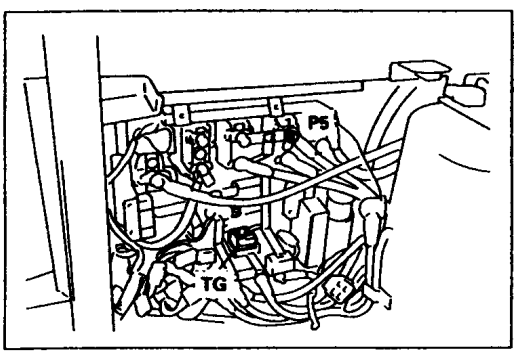
NG
- Speed sensor defect
- Wiring defect (speed sensor-CN106)

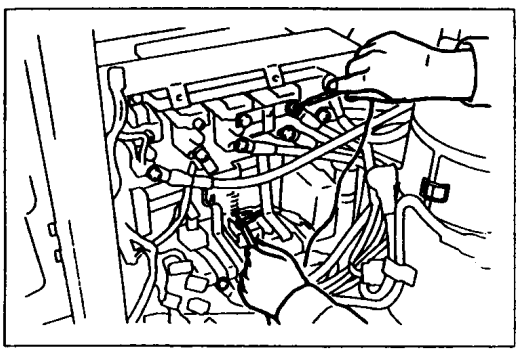
* If NG still after checking and replacing the above, the CPUboard should be judged defective.

OK
- CPU board defect
- DC-CD defect

Inspection 1. TG emitter – P5 continuity check
Battery plug OFF, RG connector disconnection

Measurement terminals	TG (E) – P5
Circuit tester range	Ω × 1
Standard	Approx. 1.5 Ω

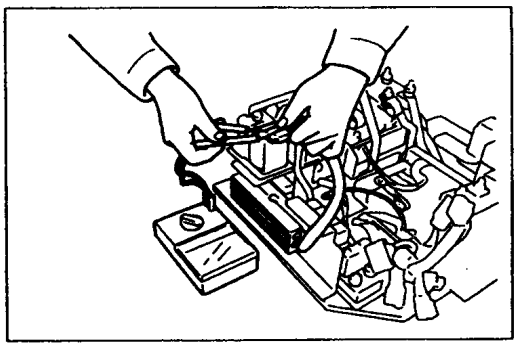




OK (approx. 1.5 Ω) → To inspection 3
NG (outside of approx. 1.5 Ω) → To inspection 2

Inspection 2. Individual RG measurement
Battery plug OFF, RG connector disconnection

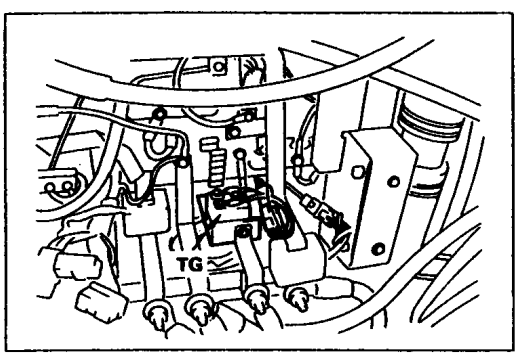
Measurement terminals	Both terminals of RG connector (RG side)
Circuit tester range	Ω × 1
Standard	Approx. 1.5 Ω

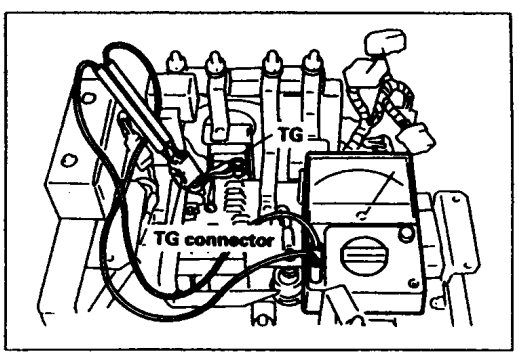


OK (approx. 1.5 Ω) → Wiring disconnection (TG (E) ~ TG contactor)
NG (outside of approx. 1.5 Ω) → RG defect

Inspection 3. Individual TG check
Battery plug OFF, TG wiring disconnection

Measurement terminals	Between B and C	B ⊖ - C ⊕ B ⊕ - C ⊖
	Between C and E	C ⊖ - E ⊕ C ⊕ - E ⊖
Circuit tester range	Ω × 1 K	
Standard	Between B and C	B ⊖ - C ⊕ : continuity shall exist B ⊕ - C ⊖ : ∞ Ω
	Between C and E	C ⊖ - E ⊕ : ∞ Ω C ⊕ - E ⊖ : continuity shall exist

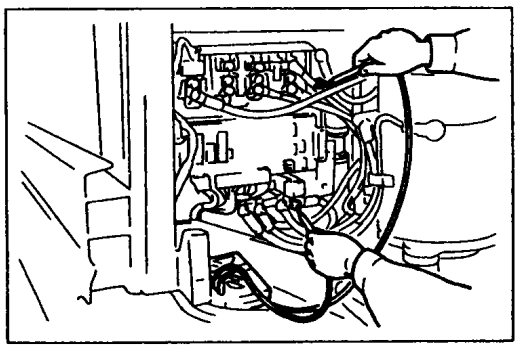




OK (standard) → To inspection 4
NG (outside of standard) → TG defect

Inspection 4. DG circuit continuity check (P4-N1)
Battery plug OFF

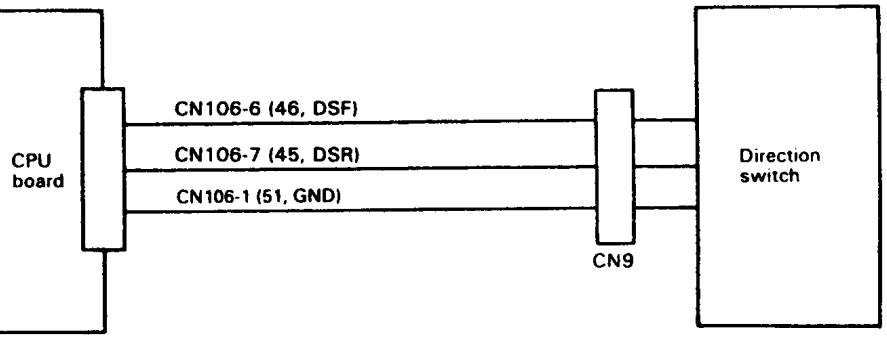
Measurement terminals	P4 ⊕ – N1 ⊖
Circuit tester range	Ω × 1 K
Standard	3 kΩ



OK (3 kΩ) → To ANL13: test operation
NG (∞ Ω) → DG open, Loosening wiring or copper bar of DG

8. The vehicle travels only in the forward or reverse direction.

Related portion



Estimated causes

① No direction switch signal input

② Open circuit in MF or MR contactor coil

ANL31: Switch input test
Is DSF/DSR turned ON and OFF when the direction lever is operated to the forward and reverse positions
See page 5-25.

NG → • Direction switch defect
• Wiring defect (DSF/DSR ~ CN106)

OK ↓

ANL11: ESY-19·20
MF or MR contactor operation check
See page 5-19.

NG → Inspection 1
MF or MR contactor coil continuity measurement

NG (∞ Ω) → MF or MR contactor replacement

OK ↓

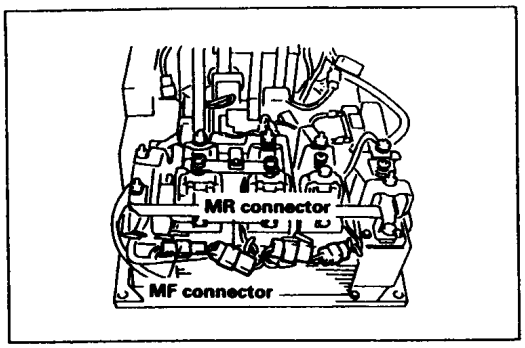
• CPU board defect

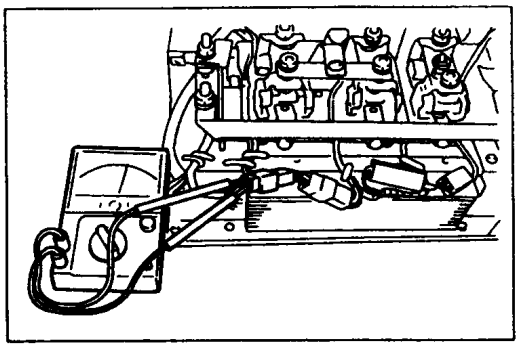
OK (approx. 35 Ω) ↓

• CPU board defect
• Wiring defect (MF/MR ~ CN104)

Inspection 1. MF or MR contactor coil continuity check
Battery plug OFF

Measurement terminals	Both terminals of MF or MR connector
Circuit tester range	Ω × 1
Standard	Approx. 35 Ω (at 20°C (68°F))



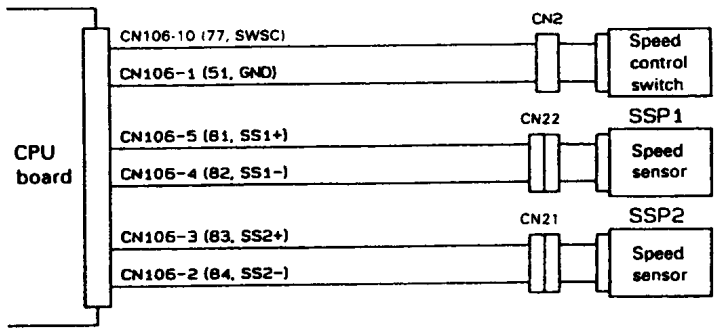


OK (approx. 35 Ω) → CPU board defect, Wiring disconnection (between CPU board and MF·MR contactor)
NG (∞ Ω) → MF or MR contactor replacement

9. The speed limiter is ineffective.

(1) The vehicle speed rises to the maximum speed.

Related portion



Estimated causes

① No speed control switch signal input

② Wheel diameter setting error

③ Speed sensor signal defect

ANL31: Switch input test
Check ON/OFF of speed control switch.
See page 5-25.

NG (OFF) →
- Speed control switch defect
- Wiring defect (speed control switch ~ CN106)

OK (ON) ↓

Tire wheel diameter check

NG (not regular tire size) → Traveling test after wheel diameter setting

OK ↓

ANL13: Test operation (No. 1)
Speed indication check
See page 5-23.

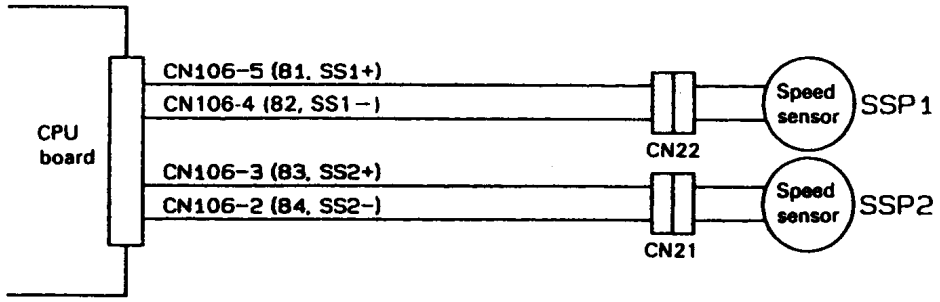
NG (great fluctuation of speed indication during at a constant speed.) →
- Speed sensor defect
- Wiring defect (speed sensor ~ CN106)

OK ↓

- CPU board defect

(2) The limited speed is abnormal.

Related portion



Estimated causes

① Wheel diameter setting error

② Speed sensor signal defect

Tire wheel diameter check

NG (not regular tire size) → Traveling test after wheel diameter setting.

OK

ANL13: Test operation (No. 1)
Speed indication check
See page 5-23.

NG (great fluctuation of speed indication during at a constant speed.) →
- Speed sensor defect
- Wiring defect (speed sensor ~ CN106)
- CPU board defect

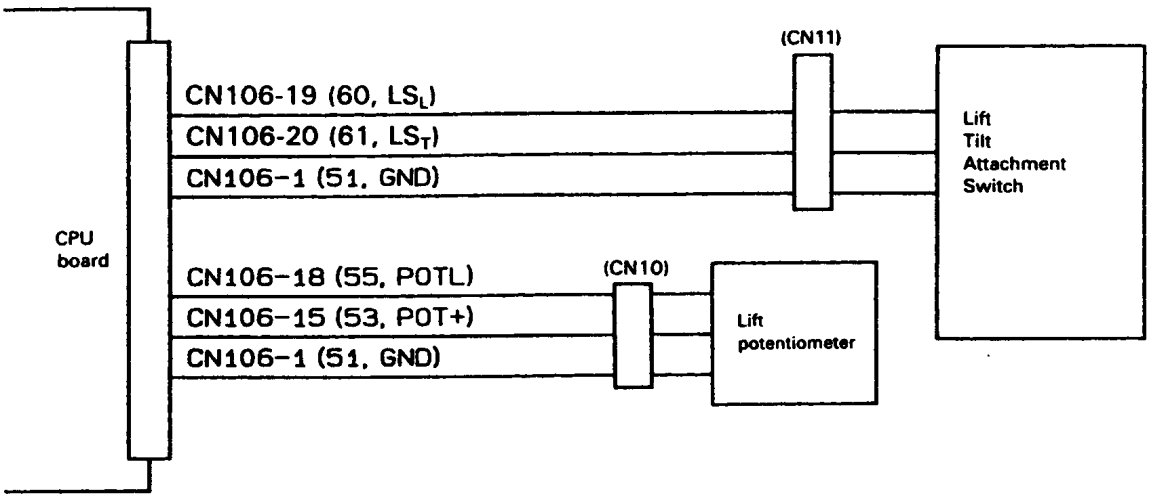
OK

CPU board defect

MATERIAL HANDLING SYSTEM

1. The material handling motor does not run.

Related portion



Estimated causes

① F2 fuse open

② Material handling switch defect

③ Pump drive motor abnormality

Inspection 1:
F2 fuse continuity check
NG (∞ Ω) → F2 fuse replacement
OK (0 Ω)

To A on next page

A

ANL31: Switch input test
Check ON/OFF of each material handling system switch.
See page 5-25.

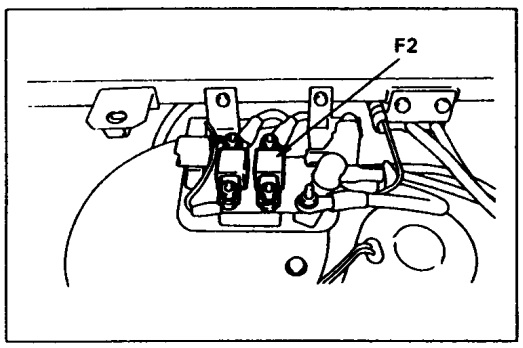
NG → • Material handling switch defect
• Wiring defect (each material handling switch ~ CN106)

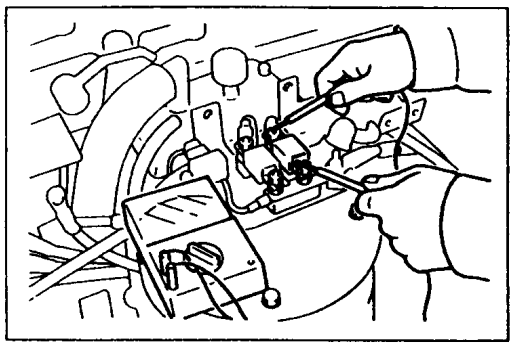
OK

- CPU board defect
- Material handling motor defect

Inspection 1. F2 fuse continuity check
Battery plug OFF

Measurement terminals	Both terminals of F2 fuse
Circuit tester range	Ω x 1
Standard	0 Ω



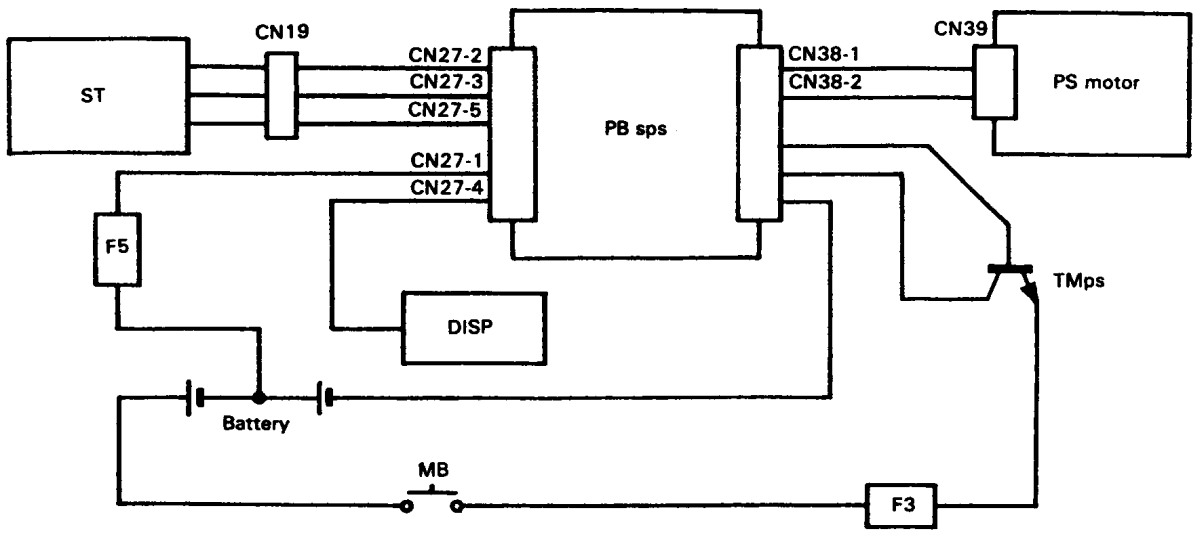


OK (0 Ω) → ANL31: switch input test
NG (∞ Ω) → F2 fuse replacement

STEERING SYSTEM

Hard to steer. (The PS motor does not start when steering wheel is operated)

Related portion



Estimated causes

① The battery voltage is not applied.	⑥ F5 (blown fuse) defect
② Key switch defect	⑦ Battery connector defect
③ SPS board (PB_{SPS}) defect	⑧ Internal open circuit in battery
④ Torque sensor defect	⑨ Wiring defect
⑤ F3 (blown fuse) defect	⑩ Controller initial wiring contact defect

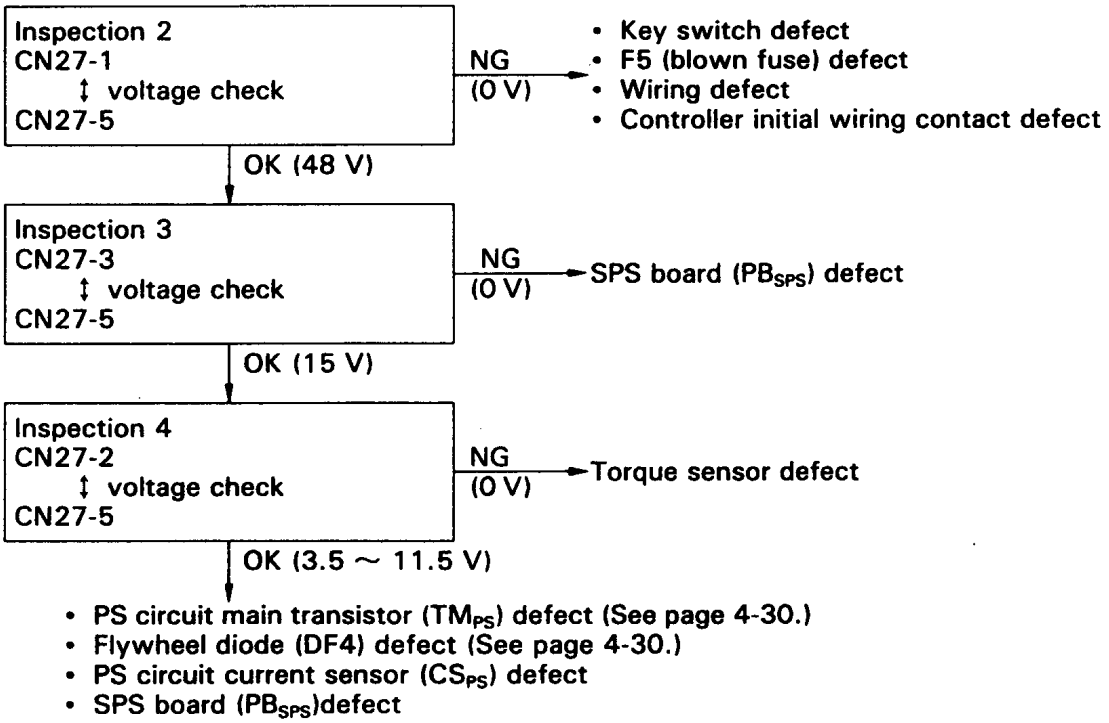
Check the connection between the harness and connector
→ NG (0 V) → Retest after connection
↓ OK (battery voltage)

Inspection 1
CN38-3
↕ voltage check
CN38-4
→ NG (0 V) →
- Battery connector defect
- F3 (blown fuse) defect
- Internal open circuit in battery

↓ OK (80 V)

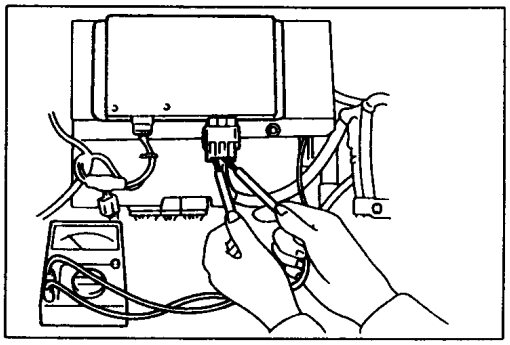
To A on next page

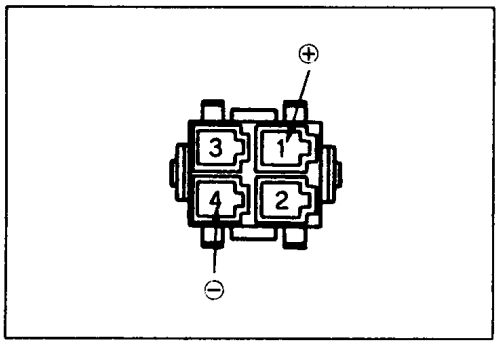
A


Inspection 2
CN27-1
↕ voltage check
CN27-5
NG
(0 V)
• Key switch defect
• F5 (blown fuse) defect
• Wiring defect
• Controller initial wiring contact defect
OK (48 V)
Inspection 3
CN27-3
↕ voltage check
CN27-5
NG
(0 V)
SPS board (PB_{SPS}) defect
OK (15 V)
Inspection 4
CN27-2
↕ voltage check
CN27-5
NG
(0 V)
Torque sensor defect
OK (3.5 ~ 11.5 V)
• PS circuit main transistor (TM_{PS}) defect (See page 4-30.)
• Flywheel diode (DF4) defect (See page 4-30.)
• PS circuit current sensor (CS_{PS}) defect
• SPS board (PB_{SPS})defect

Inspection 1. Battery voltage measurement
Battery plug ON

Measurement terminals	CN38-3 (P21, +80 V) ⊕ – CN38-4 (N1, GND) ⊖
Circuit tester range	DC 250 V
Standard	Battery voltage

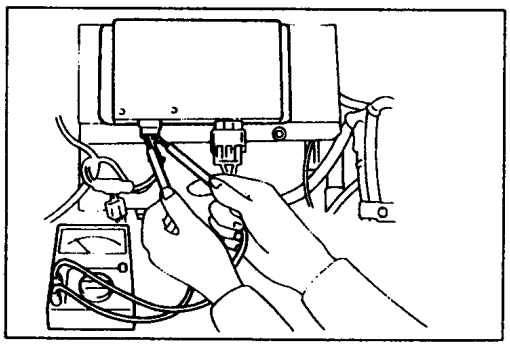


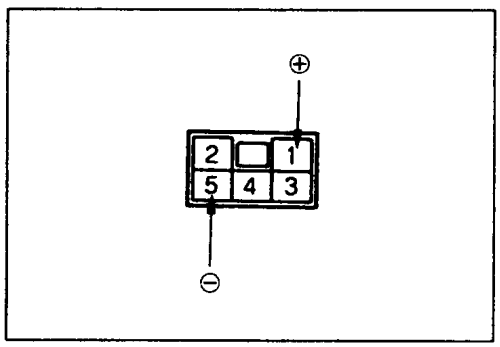


OK (battery voltage) → To inspection 2
NG (0 V) → Battery connector defect, blown F3 fuse, Internal open circuit in battery

Inspection 2. Voltage measurement after SW_{KY}
Battery plug ON, SW_{KY} ON

Measurement terminals	CN27-1 (43, +48 V) ⊕ – CN27-5 (163, GND) ⊖
Circuit tester range	DC 250 V
Standard	48 V

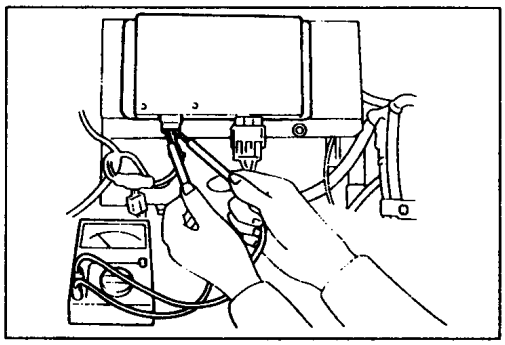


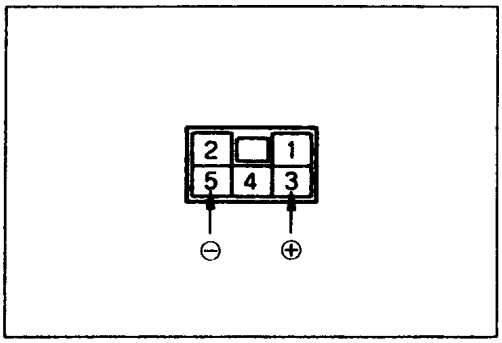


OK (48 V) → To inspection 3
NG (0 V) → SW_{KY} defect, wiring defect

Inspection 3. Voltage check between CN27-3 and CN27-5
Battery plug ON, SW_{KY} ON

Measurement terminals	CN27-3 (161, +15 V) ⊕ – CN27-5 (163, GND)
Circuit tester range	DC 50 V
Standard	15 V

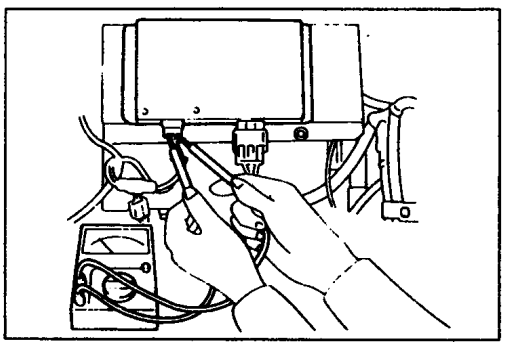


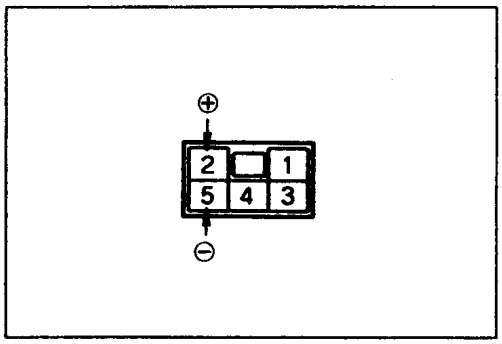


OK (15 V) → To inspection 4
NG (0 V) → SPS board (PB_{SPS}) defect

Inspection 4. Voltage check between CN27-2 and CN27-5
Battery plug ON, SW_{KY} ON

Measurement terminals	CN27-2 (162, ST) ⊕ – CN27-5 (163, GND)
Circuit tester range	DC 50 V
Standard	3.5 ~ 11.5 V



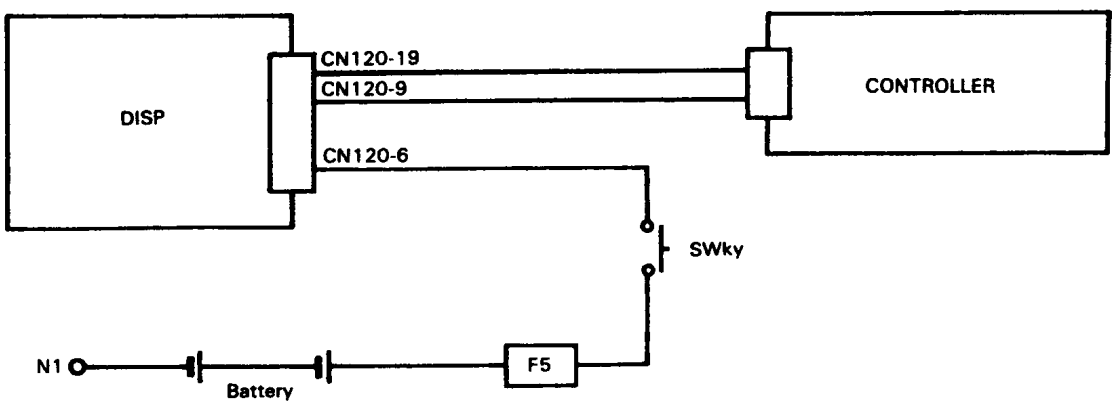


OK (3.5 ~ 11.5 V) → Display defect, defective wiring (short circuit) between CN107 and display, CPU board defect
NG (0 V) → Torque sensor defect

DISPLAY

1. All indications do not appear.

Related portion



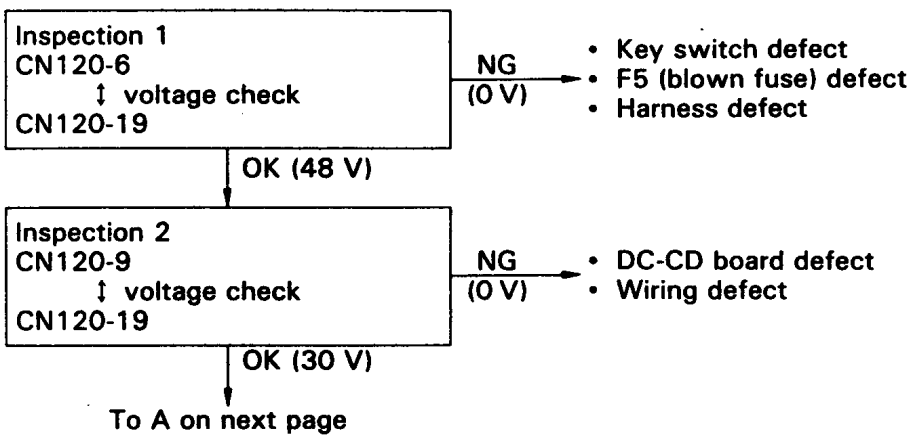
Estimated causes

① Key switch defect

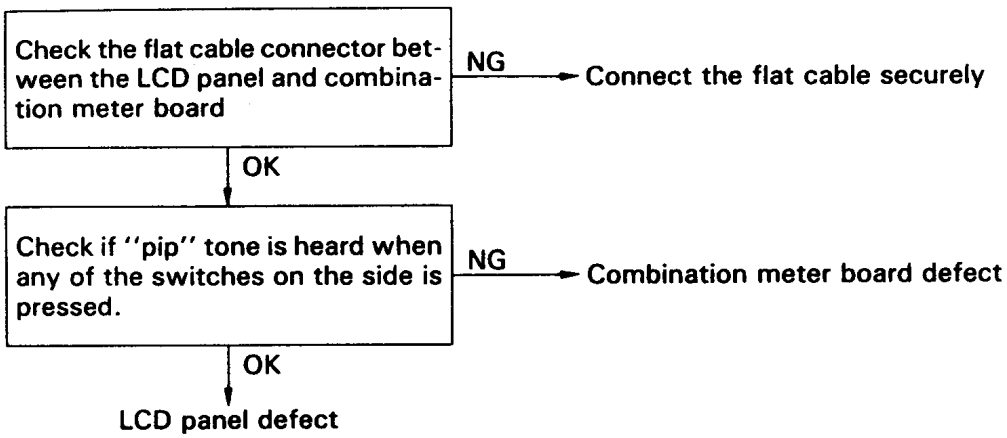
② DC-CD board defect

③ LCD panel defect

④ Combination meter board defect

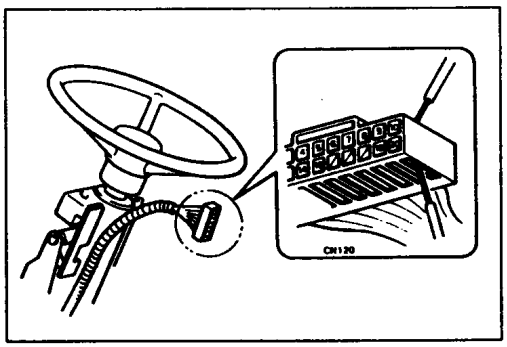


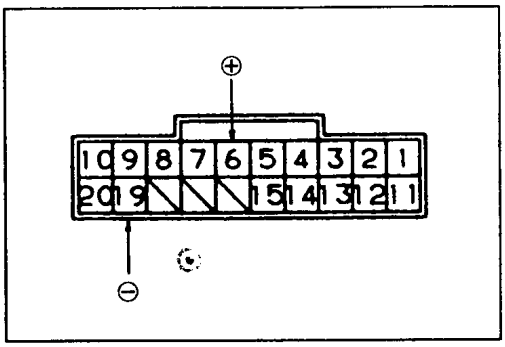
A


Check the flat cable connector between the LCD panel and combination meter board
NG
Connect the flat cable securely
OK
Check if "pip" tone is heard when any of the switches on the side is pressed.
NG
Combination meter board defect
OK
LCD panel defect

Inspection 1: Voltage check between CN120-6 and CN120-19
Battery plug ON

Measurement terminals	CN120-6 (43, +48 V) ⊕ – CN120-19 (17, GND) ⊖
Circuit tester range	DC 50 V
Standard	48 V

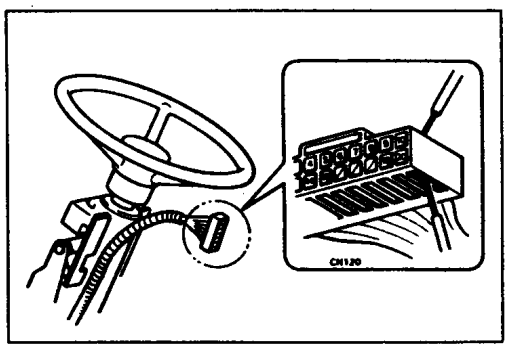


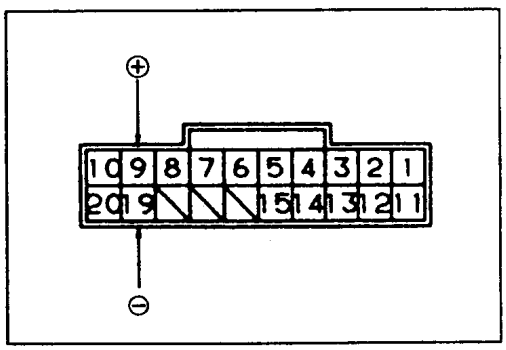


OK (48 V) → To inspection 2
NG (0 V) → Key switch defect·F5 (blown fuse) defect·harness defect

Inspection 2: Voltage check between CN120-9 and CN120-19
Battery plug ON

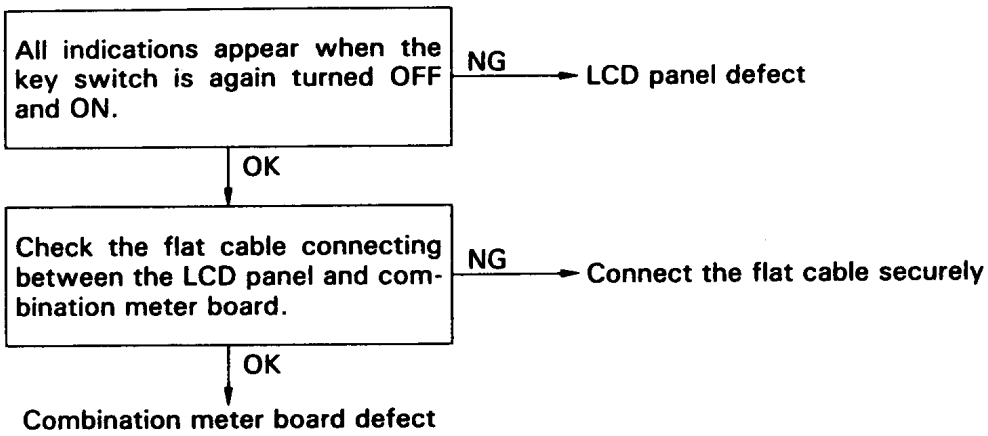
Measurement terminals	CN120-9 (16, +30 V) ⊕ – CN120-19 (17, GND) ⊖
Circuit tester range	DC 50 V
Standard	25.5 ~ 30.5 V



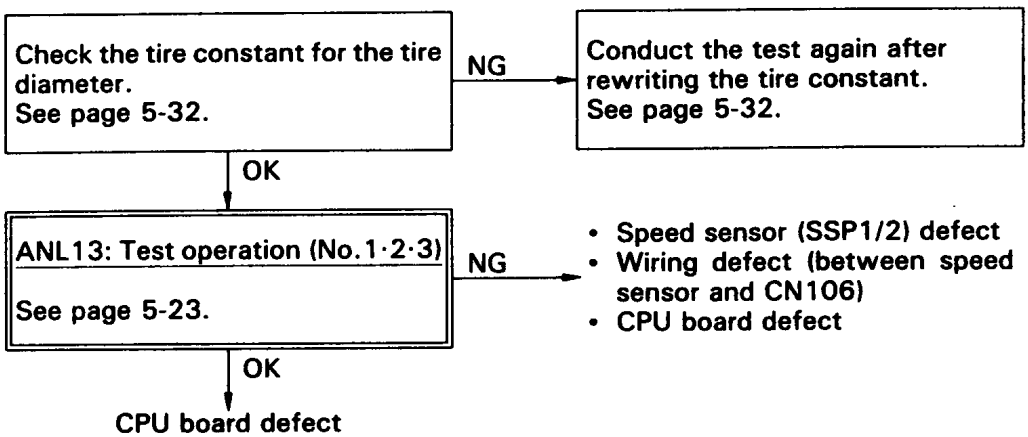


OK (25.5 ~ 30.5 V) → Check the flat cable connector between LCD panel and combination meter board.
NG (0 V) → DC-CD board defect, wiring defect

2. Partial indications do not appear.

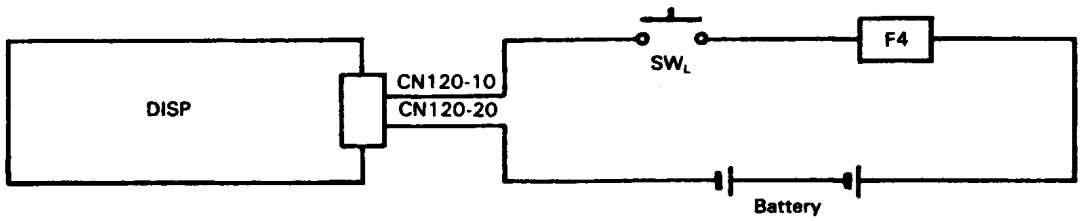


3. Speedometer indication error is excessive.



4. Back light is not lit.

Related portion



Estimated causes

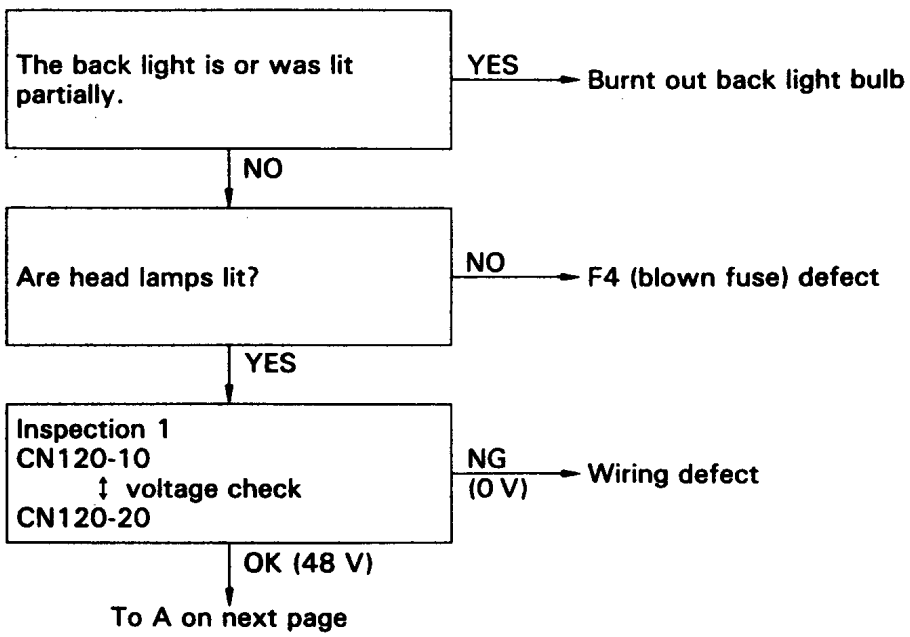
① Burnt out back light bulb

② F4 (blown fuse) defect

③ Wiring defect

④ The flat cable connector between LCD panel and combination meter board disconnection

⑤ Combination meter board defect

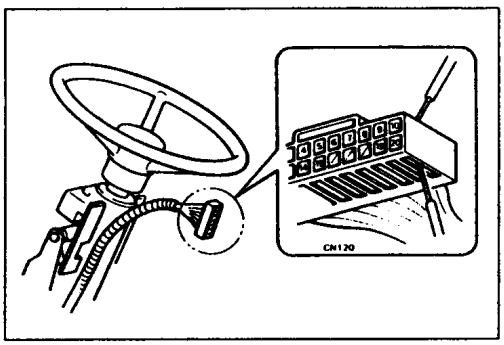


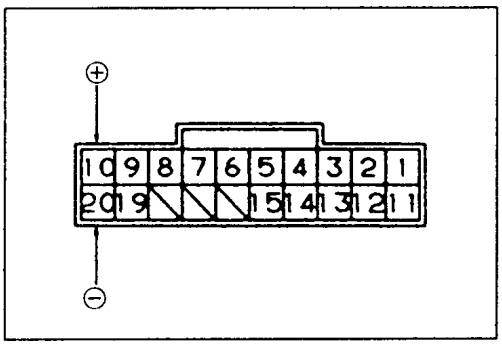
A

Check the flat cable connecting the LCD panel and combination meter board.
NG → Connect the flat cable securely
OK
Combination meter board defect

Inspection 1: Voltage check between CN120-10 and CN120-20
Battery plug ON

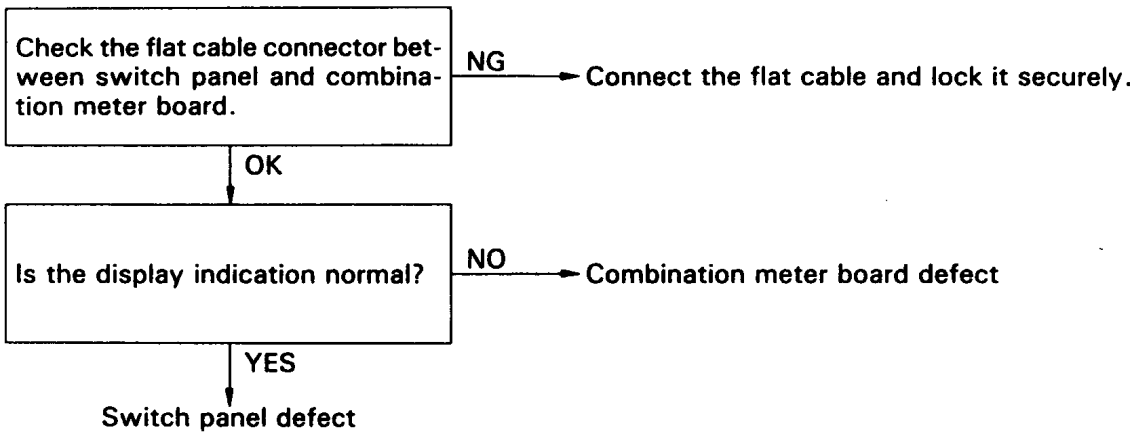
Measurement terminals	CN120-10 (104, BL) ⊕ – CN120-20 (N1, GND) ⊖
Circuit tester range	DC 50 V
Standard	48 V





OK (48 V) → Check the flat cable connector between LCD panel and combination meter board.
NG (0 V) → Wiring defect

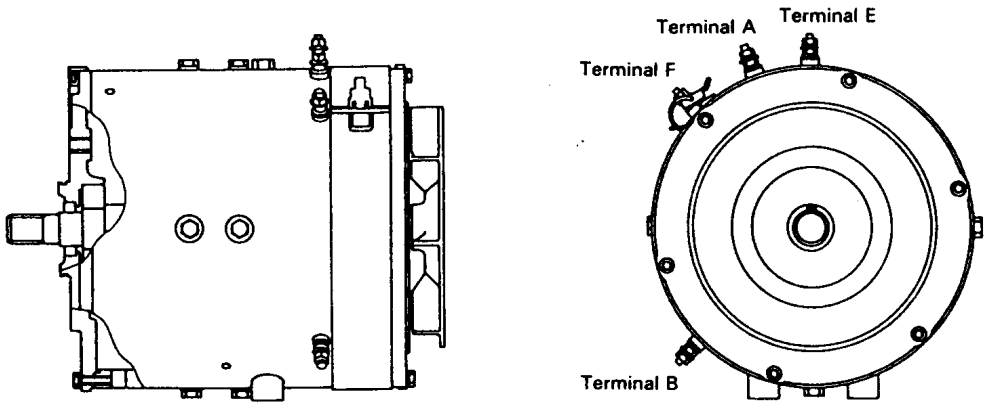
5. Power control switch does not operate.



MOTORS

DRIVE MOTOR

GENERAL

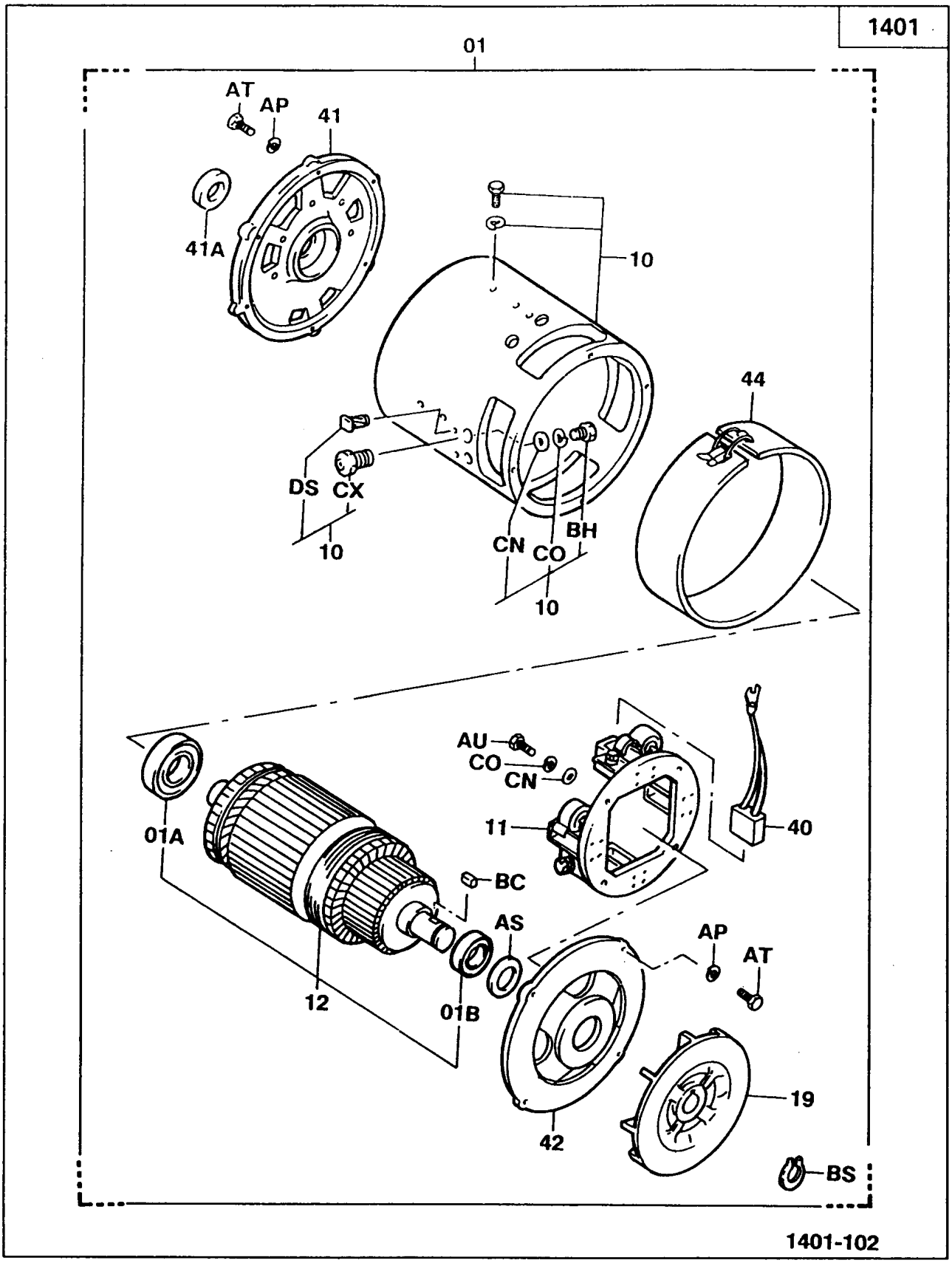


Drive Motor BARM 10

SPECIFICATIONS

Item \ Model		FBMF 16	FBMF20 · 25 · 30
Type		DC series wound open type	DC series wound open type
Nominal voltage	V	72/80	72/80
Rated output	kW	7.6/8.6	10.1/10.6
Insulation class		F	F
Brush size (thickness × width × length)	mm (in)	12.5×40×34 (0.49×1.57×1.34)	16×40×34 (0.63×1.57×1.34)
Number of brushes		4	4
Weight	kg (lb)	81 (179)	114 (251)

COMPONENTS


1401
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41A
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DS
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CN
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BH
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AU
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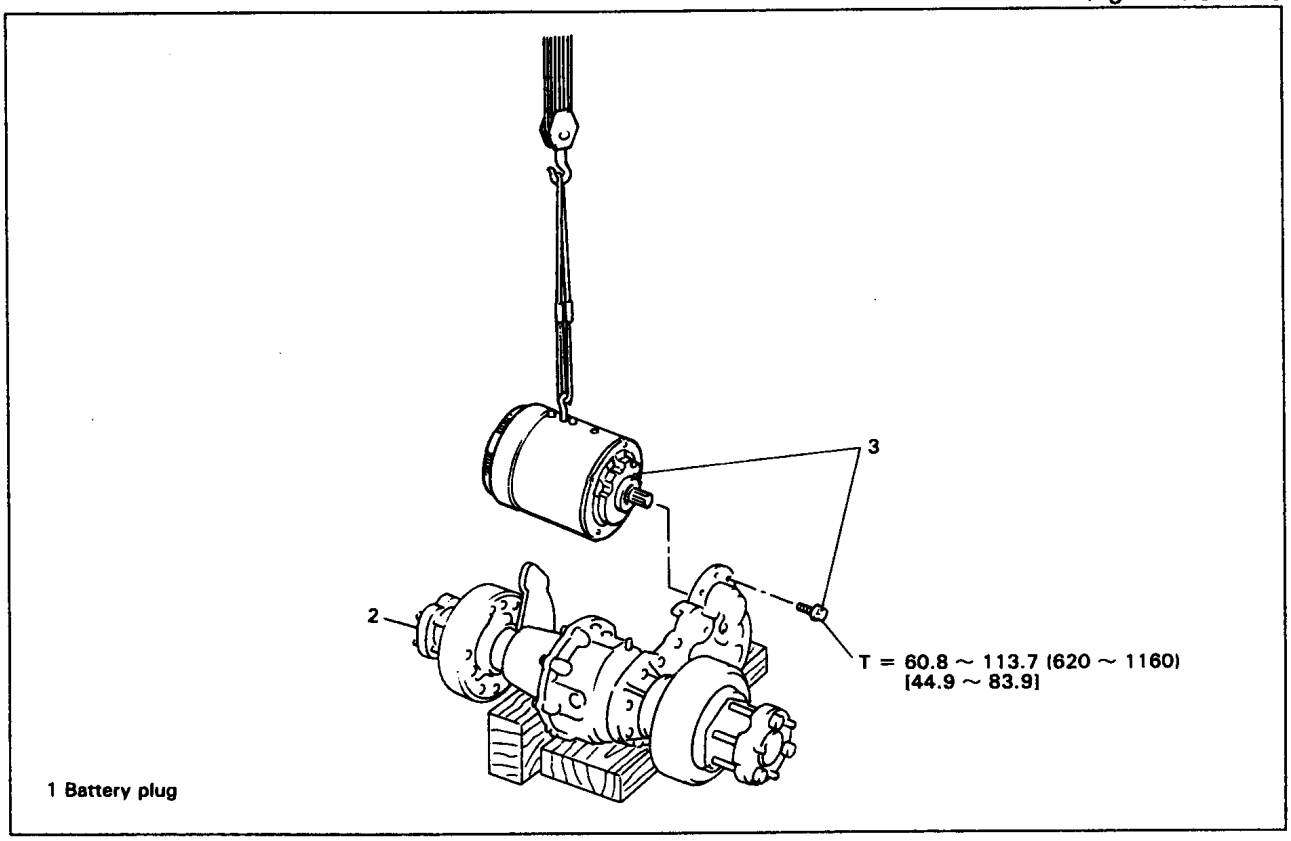
CN
11
40
01A
BC
AS
AP
AT
12
01B
42
19
BS
1401-102

REMOVAL · INSTALLATION

T = N·m (kgf-cm) [ft-lbf]



Removal Procedure

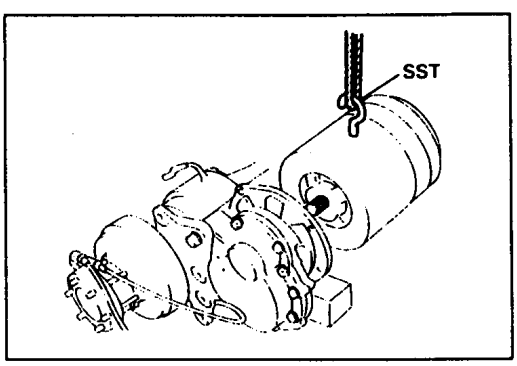
1 Disconnect the battery plug.

2 Remove the drive unit. (See page 8-5)

3 Remove the drive motor. [Point 1]

Installation Procedure

The installation procedure is the reverse of the removal procedure.



Point Operation

[Point 1]

Removal·Installation: SST 09010-10260-71

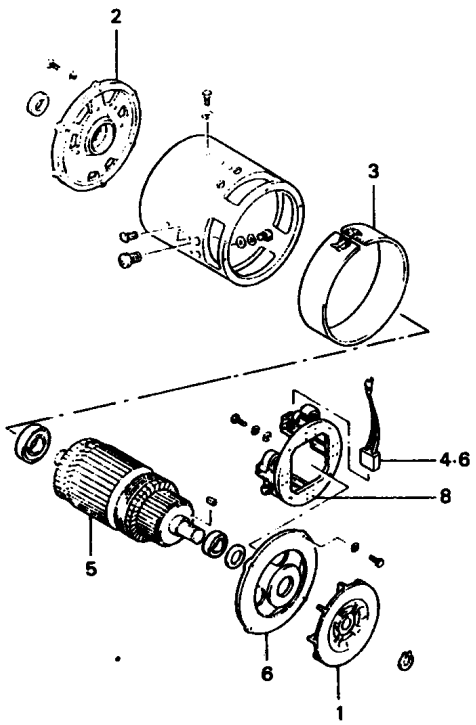
Drive motor weight:

FBMF16	81 kg (179 lb)
FBMF20 · 25 · 30	114 kg (251 lb)

DISASSEMBLY · INSPECTION · REASSEMBLY

Note:
Measure the insulation resistance between each terminal and motor body before disassembly.

Standard: 1 MΩ or more (with a 500 V DC megger)



Disassembly Procedure

1 Remove the fan. **[Point 1]**

2 Remove the bracket No. 1. **[Point 2]**

3 Remove the brush cover.

4 Set the brushes free.

5 Remove the armature coil. **[Point 3]**

6 Remove the bracket No. 2. **[Point 4]**

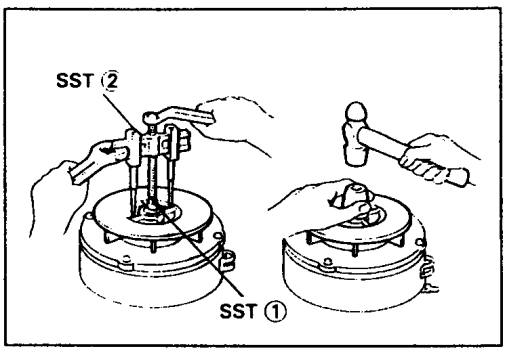
7 Remove 4 brushes from the brush holder. **[Point 5]**

8 Remove the brush holder from the bracket No. 2.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

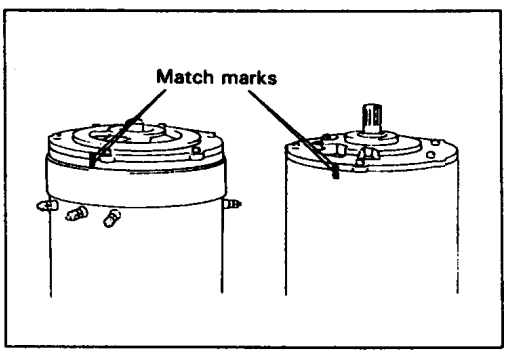
Notes:
- **Measure the insulation resistance between each cable and motor body.**
  Standard: 1 MΩ or more (with a 500 V DC megger)
- **Inspect the field coil continuity by measurement between terminal E and F.**
  Standard: 0 Ω (circuit tester range × 1 Ω)



Point Operations

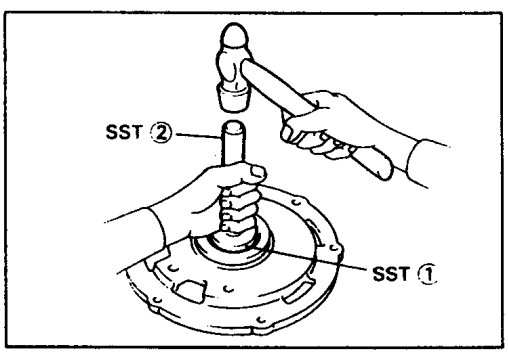
[Point 1]

Disassembly: SST 09950-76014-71 (SST 09950-40011)····①
SST 09950-76001-71 (SST 09950-50010)....②
Reassembly: Use a socket for reassembly.

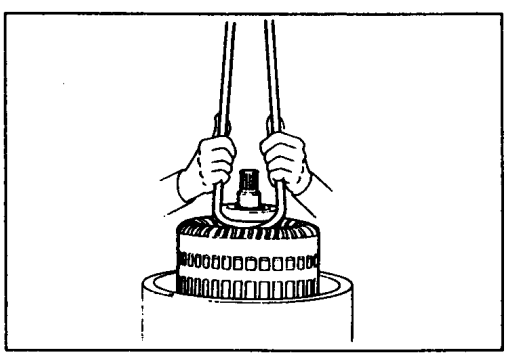


[Point 2]

Disassembly: Put match marks on the bracket No. 1 and yoke. (Same for the bracket No. 2 and yoke.)
Reassembly: Align the match marks.

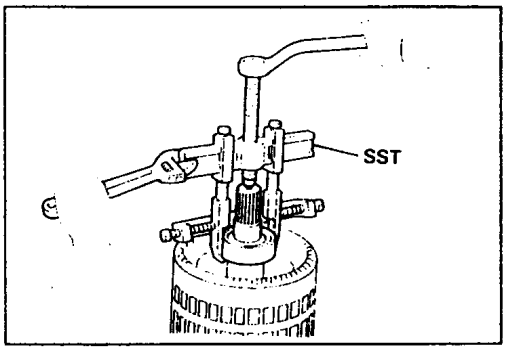


Disassembly: Using a screw driver, remove the oil seal.
Reassembly: SST 09950-76018-71 (SST 09950-60010)....①
SST 09950-76020-71 (SST 09950-70010)....②
After installation, coat grease on the oil seal lip.

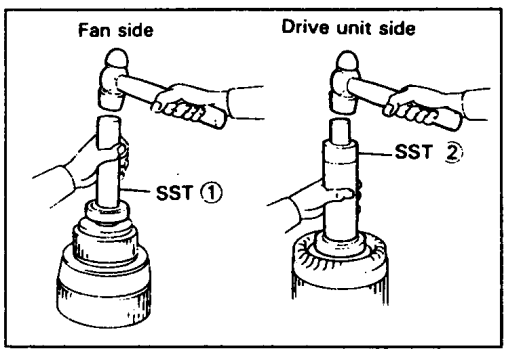


[Point 3]

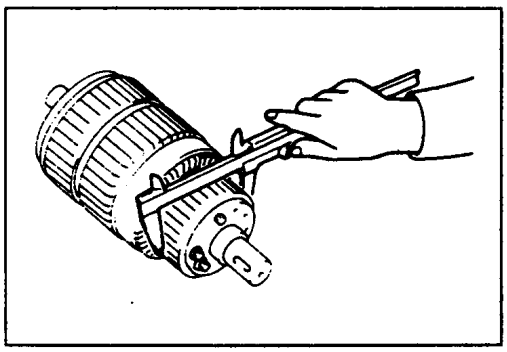
Disassembly·Reassembly: Carefully operate so as not to damage the armature coil and field coil.



Disassembly: SST 09950-76014-71 (SST 09950-40011)



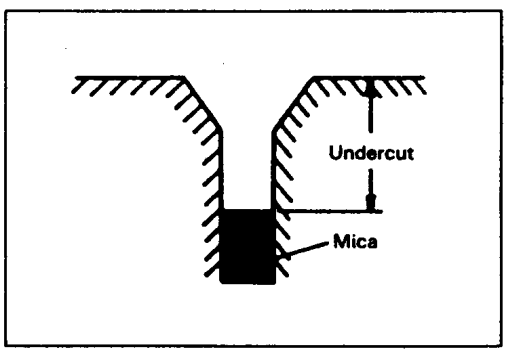
Reassembly:
Fan side bearing:
SST 09608-04031 ..... ①
Drive unit side bearing:
FBMF16
SST 09316-76008-71 (SST 09316-60011)·····②
FBMF20·25·30
SST 09309-76004-71 (SST 09309-37010)·····②



Inspection: If the commutator surface is roughened, clean well after correcting it with sandpaper (about # 600).
If heavily roughened, correct with a lathe.

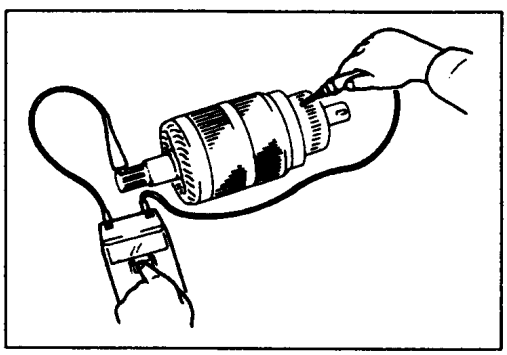
Commutator outside diameter Unit: mm (in)

	FBMF 16	FBMF20 · 25 · 30
Standard	115 (4.53)	150 (5.91)
Limit	112 (4.41)	147 (5.79)



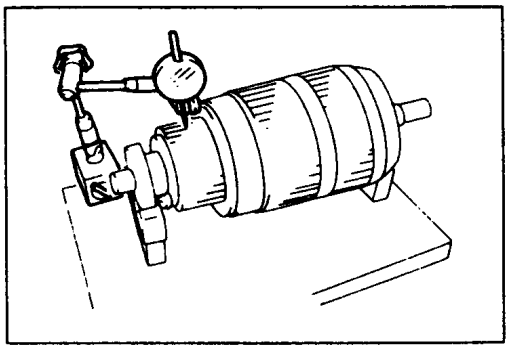
Inspection: Undercut the mica portion when the commutator is corrected.

Undercut
Standard: 1.0 mm (0.039 in)
Limit: 0.5 mm (0.020 in)



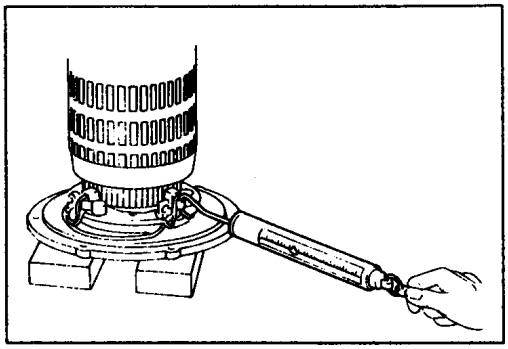
Inspection: Measure the armature coil insulation resistance.

Standard: 1 MΩ or more



Inspection: Measure the commutator runout.

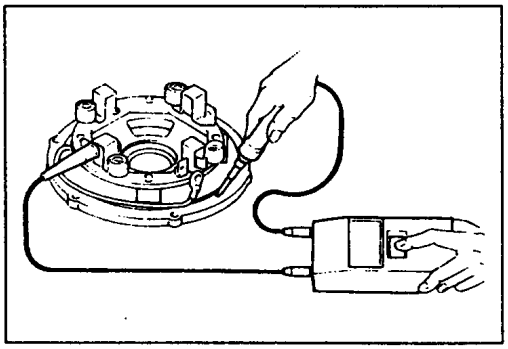
Standard: 0.03 mm (0.0012 in) or less



[Point 4]

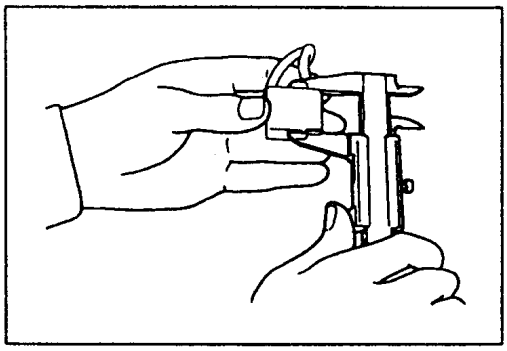
Inspection: Install the armature and brushes. Set a spring scale on the brush spring and measure the spring force on the instant when the spring leaves from the brush.

Standard:
FBMF16
13.2 N(1.35 kgf)[3.0 lbf]±10%
FBMF20 · 25 · 30
15.7 N(1.60 kgf)[3.5 lbf]±10%



Inspection: Measure the insulation resistance between the brush holder and bracket.

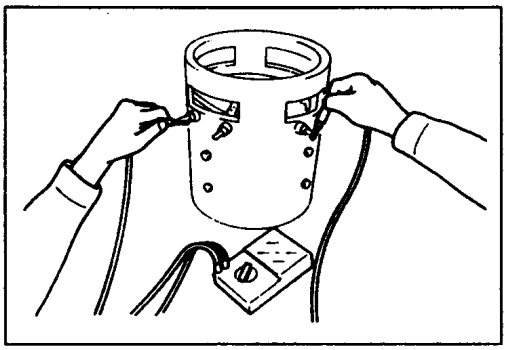
Standard: 1 MΩ or more



[Point 5]

Inspection: Inspect each brush for wear and contact.

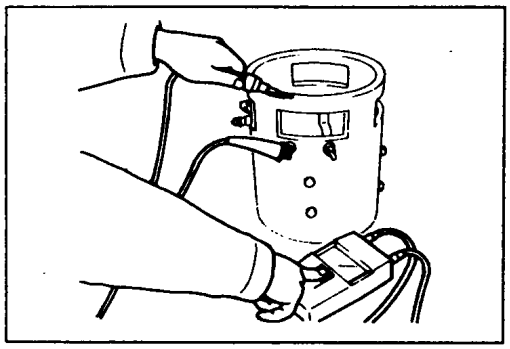
Standard: 34 mm (1.34 in.)
Wear limit: 13 mm (0.51 in.)



[Point 6]

Inspection: Inspect continuity of the field coil.

Terminals to be measured: Between E and F
Standard: 0 Ω (circuit tester range × 1 Ω)

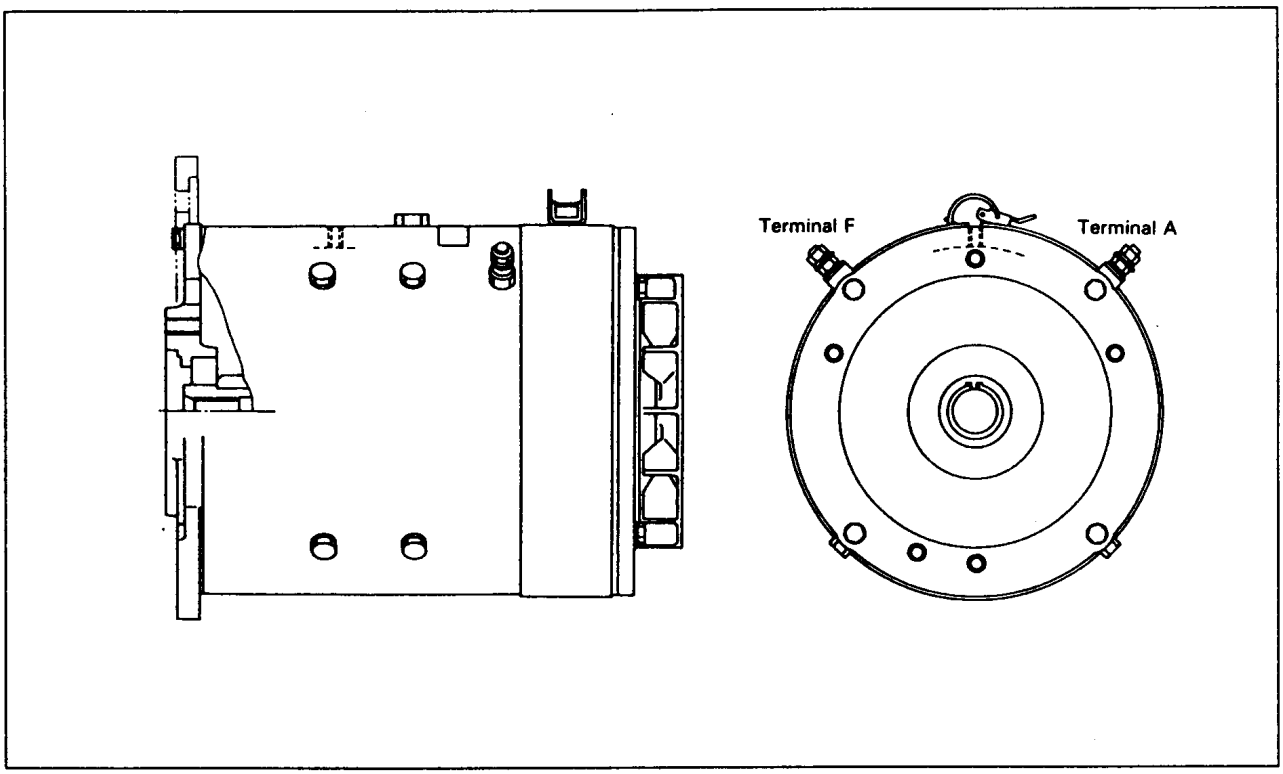


Inspection: Measure the field coil insulation resistance.

Terminals to be measured:
Between yoke and terminal E or F
Standard: 1 MΩ or more

PUMP MOTOR

GENERAL

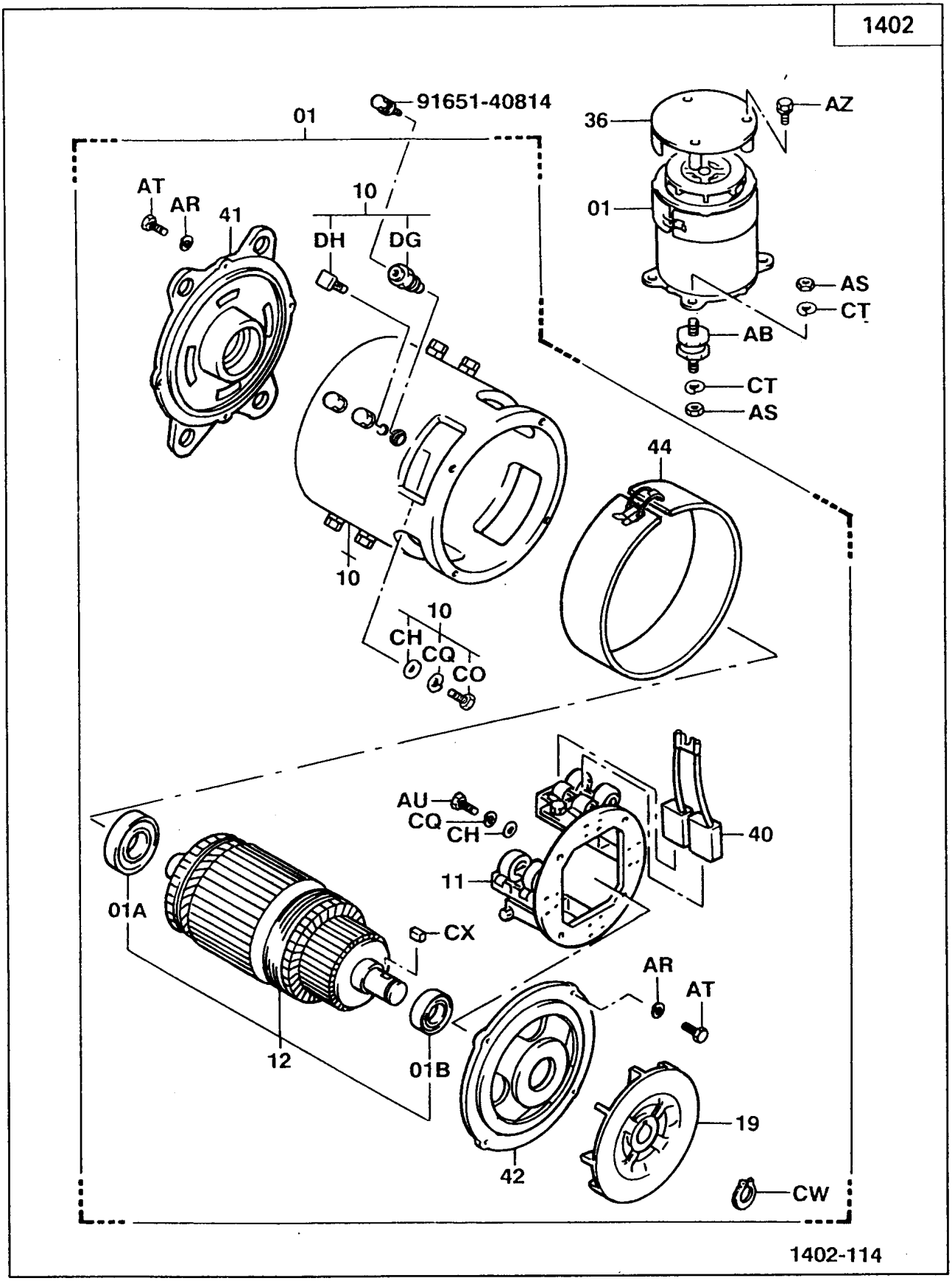


Pump Motor BARM11

SPECIFICATIONS

Item \ Model	FBMF16	FBMF20 · 25	FBMF30
Type	DC series wound open type	DC compound wound open type	DC compound wound open type
Nominal voltage V	72/80	72/80	72/80
Rated output kW	11.5/13.0	14.8/17.0	16.5/18.5
Insulation class	F	F	F
Brush size (thickness × width × length) mm (in)	12.5×40×34 (0.492×1.57×1.34)	12.5×30×34 (0.492×1.18×1.34)	12.5×30×34 (0.492×1.18×1.34)
Number of brushes	4	8	8
Weight kg (lb)	64 (141)	71 (157)	73 (161)

COMPONENTS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CH
CQ
CO
AU
CQ
CH
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11
01A
CX
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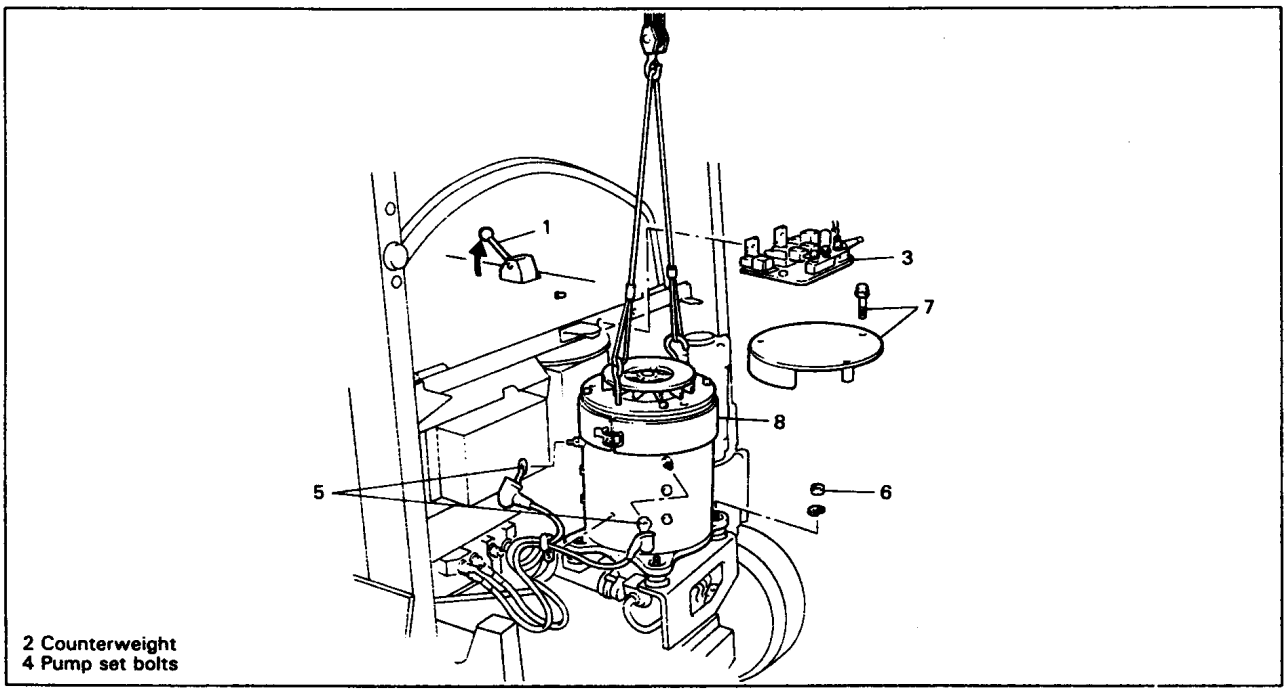
12
01B
42
19
CW
1402-114

REMOVAL · INSTALLATION



Removal Procedure

1 Disconnect the battery plug.

2 Remove the counter weight. (See page 13-6)

3 Remove the fuse bracket.

4 Remove the pump set bolts.

5 Disconnect the pump motor cables.

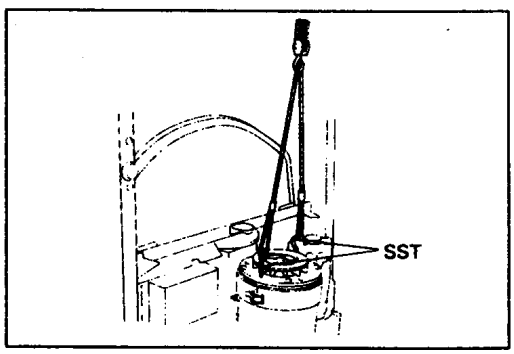
6 Remove the pump motor set nuts.

7 Remove the fan cover.

8 Remove the pump motor. **[Point 1]**

Installation Procedure

The installation procedure is the reverse of the removal procedure



Point Operation

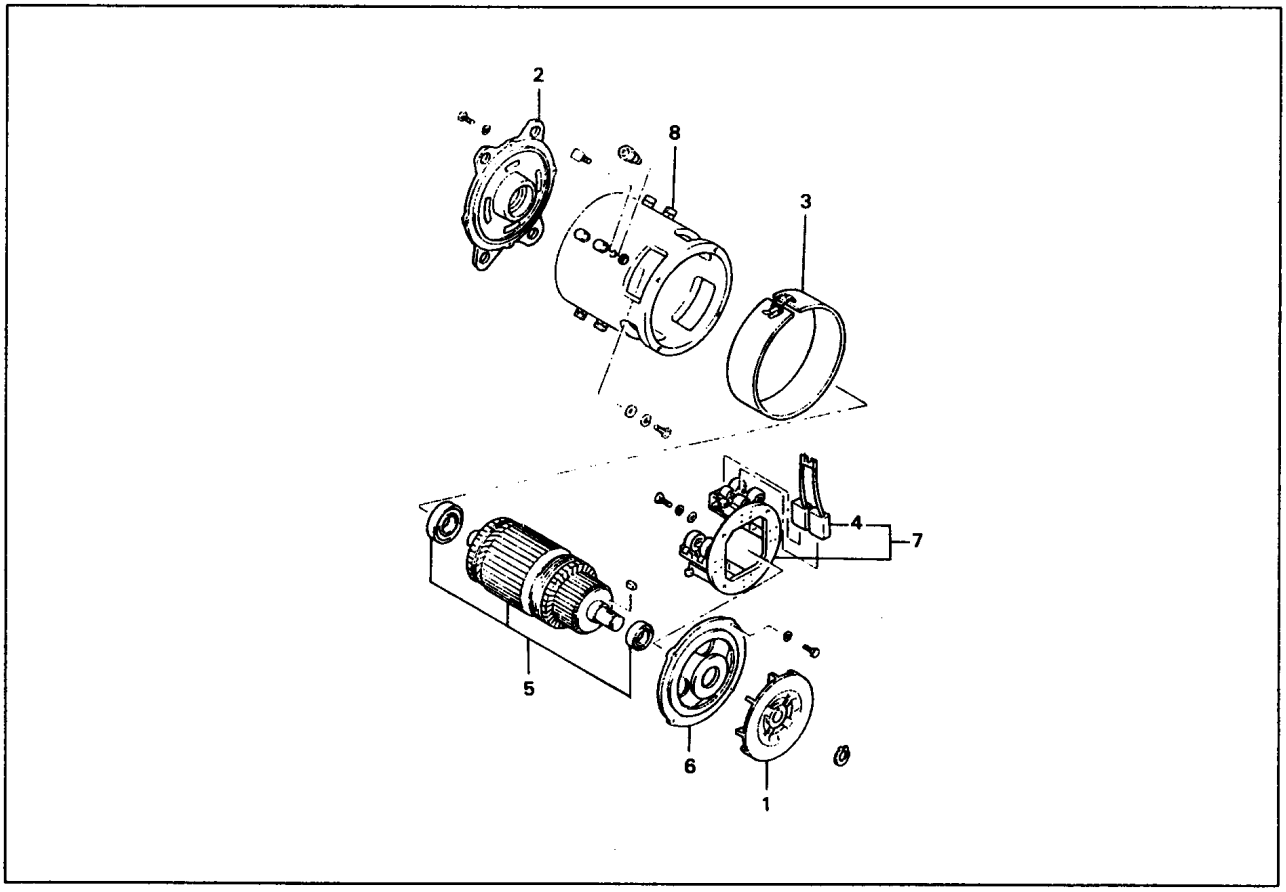
[Point 1]

Removal · Installation: SST 09010-13200-71

DISASSEMBLY·INSPECTION·REASSEMBLY

Note:
Measure the insulation resistance between each terminal and motor body before disassembly.

Standard: 1 MΩ or more (with a 500 V DC megger)



Disassembly Procedure

1 Remove the fan. **[Point 1]**

2 Remove the bracket No. 1. **[Point 2]**

3 Remove the brush cover.

4 Set the brushes free.

5 Remove the armature coil. **[Point 3]**

6 Remove the bracket No. 2. **[Point 4]**

7 Remove the brush holder. **[Point 5]**

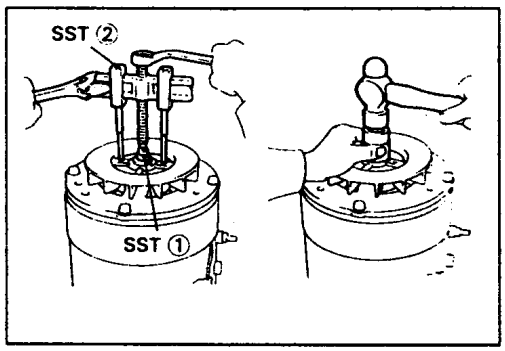
8 Remove the yoke ASSY. **[Point 6]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

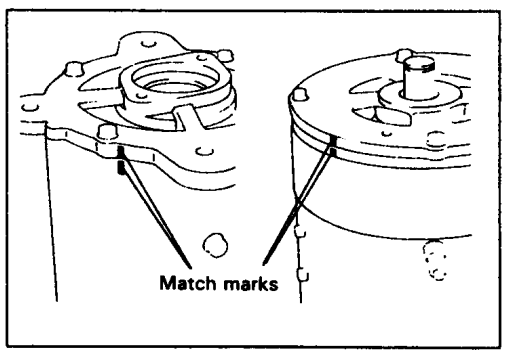
- **Measure the insulation resistance between each terminal and motor body.**
  Standard: 1MΩ or more (with a 500 V DC megger)
- **Inspect the field coil continuity between field coil and terminals E and F.**
  Standard: 0 Ω (circuit tester range ×1 Ω)



Point Operations

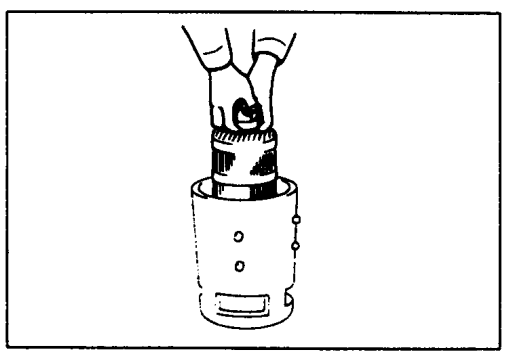
[Point 1]

Disassembly: SST 09950-76014-71 (SST 09950-40011)····①
SST 09950-76001-71 (SST 09950-50010)····②
Reassembly: Use a socket for reassembly.



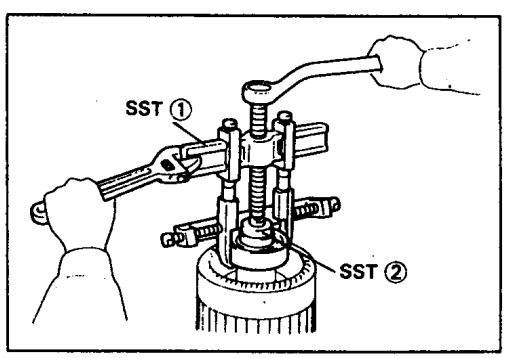
[Point 2]

Disassembly: Put match marks on the bracket No. 1 and yoke. (Same for the bracket No. 2 and yoke.)
Reassembly: Align the match marks.

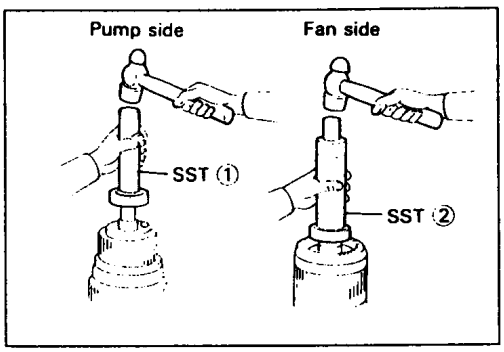


[Point 3]

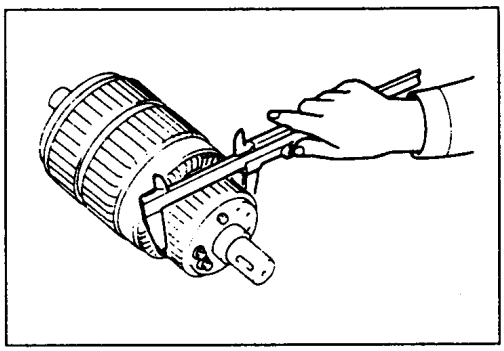
Disassembly·Reassembly: Carefully operate so as not to damage the armature coil and field coil.



Disassembly: SST 09950-76014-71 (SST 09950-40010)····①
Pump side bearing only:
SST 09950-76018-71 (SST 09950-60010)····②

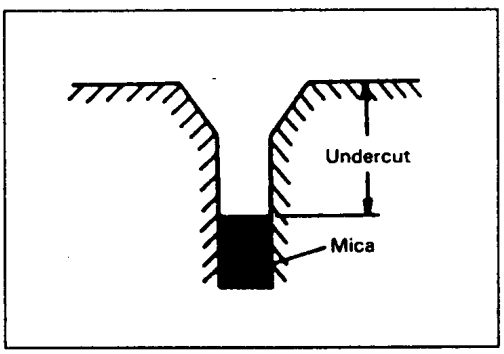


Reassembly:
Fan side bearing:
SST 09608-76003-71 (SST 09608-04031)····①
Pump side bearing:
SST 09316-76008-71 (SST 09316-60011)····②



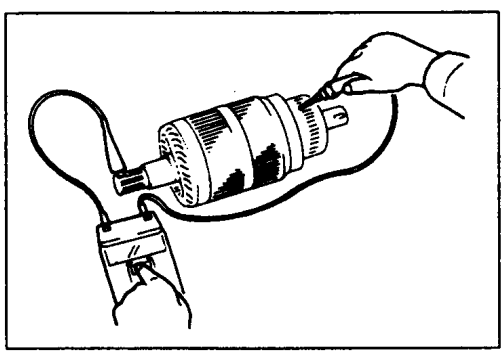
Inspection: If the commutator surface is roughened, clean carefully after correcting with sandpaper (about #600).
If heavily roughened, correct with a lathe.

Commutator outside diameter
Standard 105 mm (4.13 in)
Limit 102 mm (4.02 in)



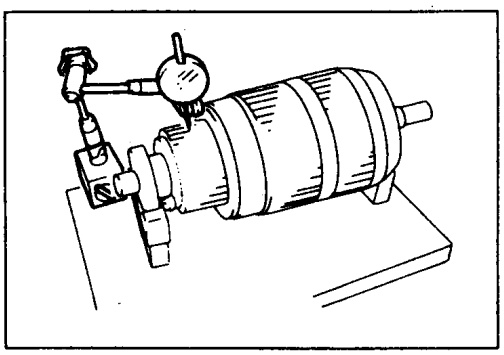
Inspection: Undercut the mica portion when the commutator is corrected.

Undercut
Standard: 1.0 mm (0.039 in)
Limit: 0.5 mm (0.020 in)



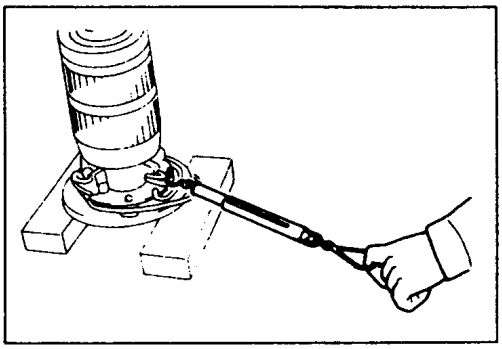
Inspection: Measure the armature coil insulation resistance.

Standard: 1 MΩ or more



Inspection: Measure the commutator runout.

Standard: 0.03 mm (0.0012 in) or less

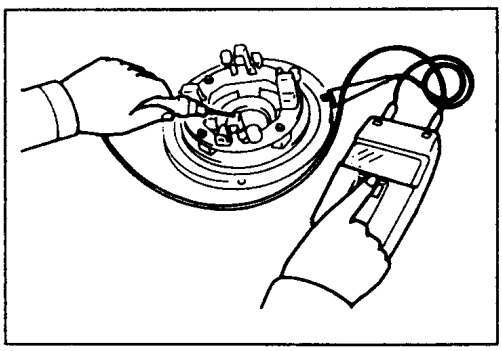


[Point 4]

Inspection: Install the armature and brushes. Set a spring scale on a brush spring and measure the spring force on the instant when the spring leaves from the brush.

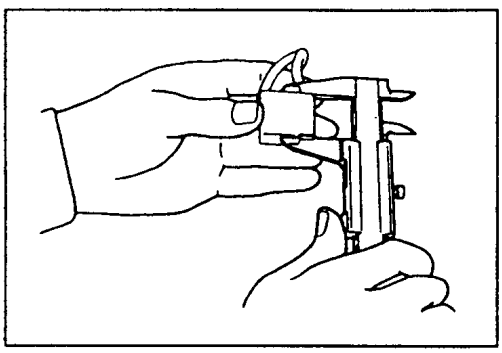
Spring force

Model	Standard N(kgf)[lbf]
FBMF16	13.24 (1.35)[2.98] ± 10 %
FBMF20 · 25 · 30	10.10 (1.03)[2.27] ± 10 %



Inspection: Measure the insulation resistance between the brush holder and bracket.

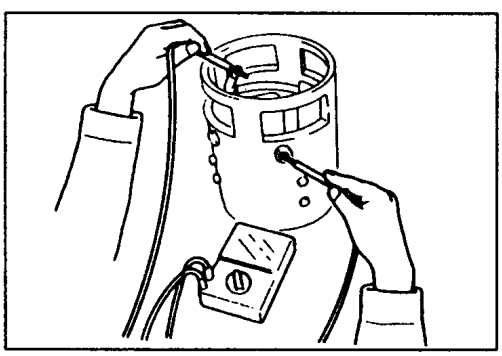
Standard: 1 MΩ or more



[Point 5]

Inspection: Inspect each brush for wear and contact state.

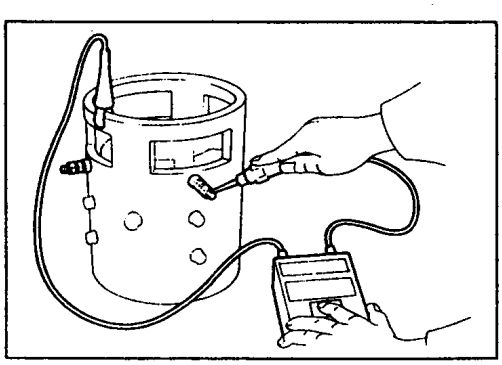
Brush length
Standard: 34 mm (1.34 in)
Limit: 13 mm (0.51 in)



[Point 6]

Inspection: Measure the field coil continuity.

Terminals to be measured:
Between field coil and terminals E and F
Standard: 0 Ω (circuit tester range × 1 Ω)

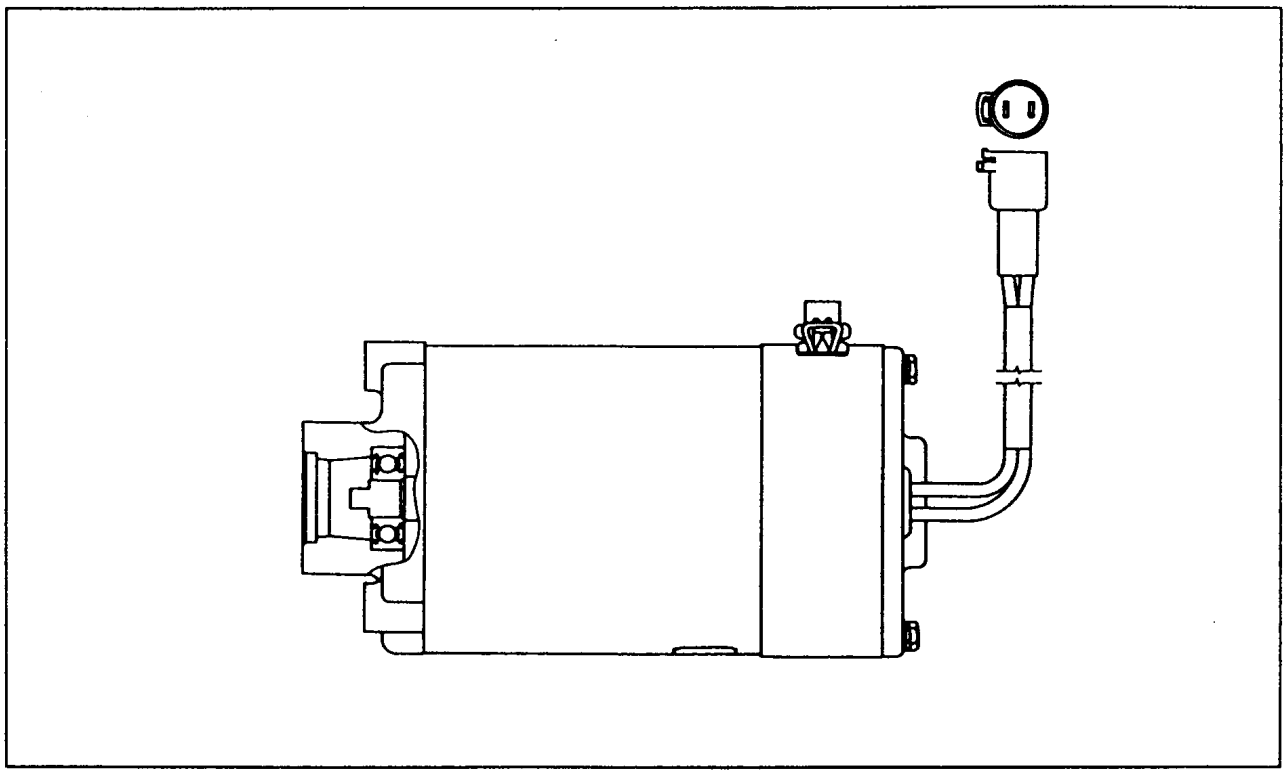


Inspection: Measure the field coil insulation resistance.

Terminals to be measured:
Between yoke and terminal A or F
Standard: 1 MΩ or more

PS MOTOR

GENERAL



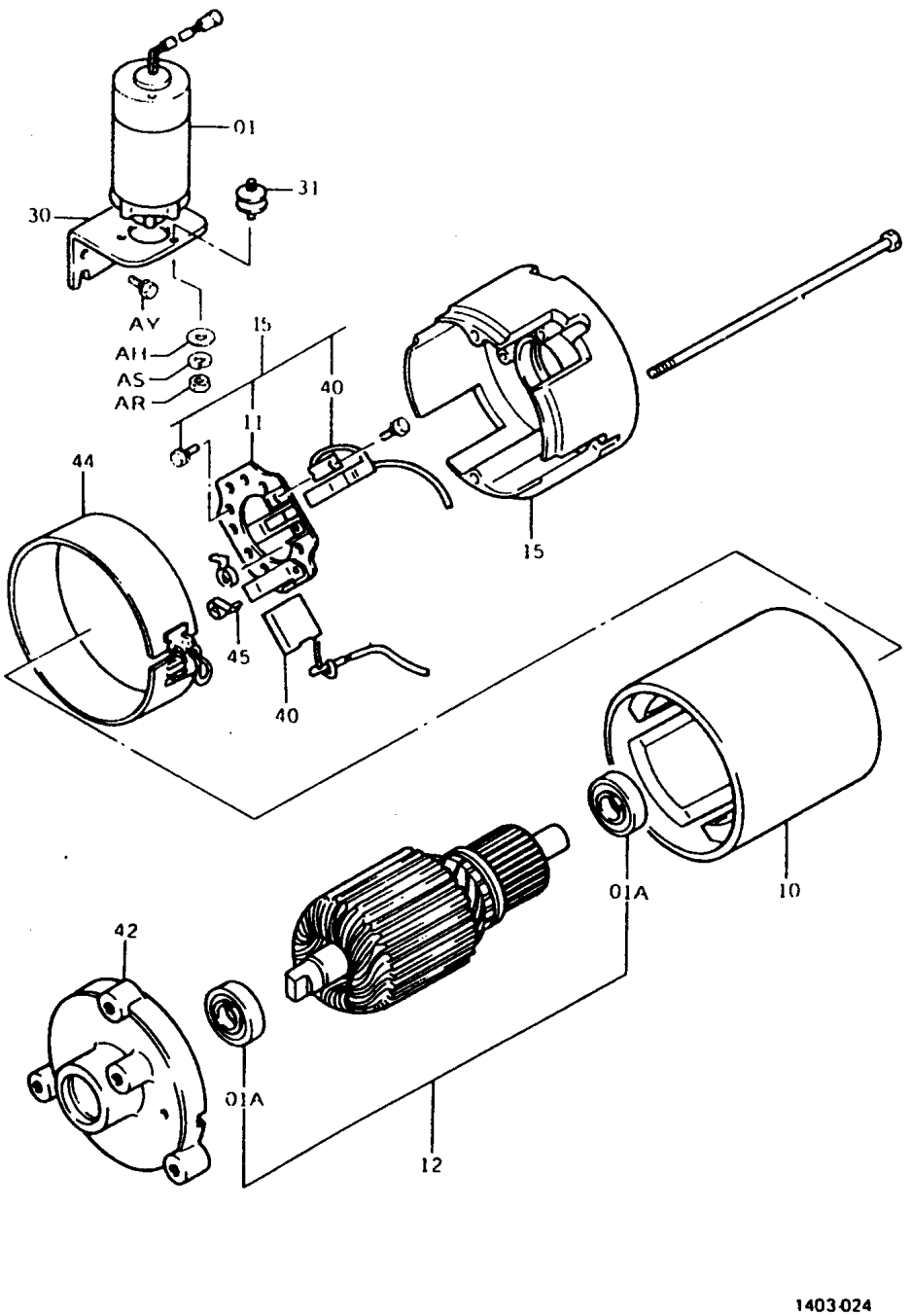
Power Steering Motor BARM12

SPECIFICATIONS

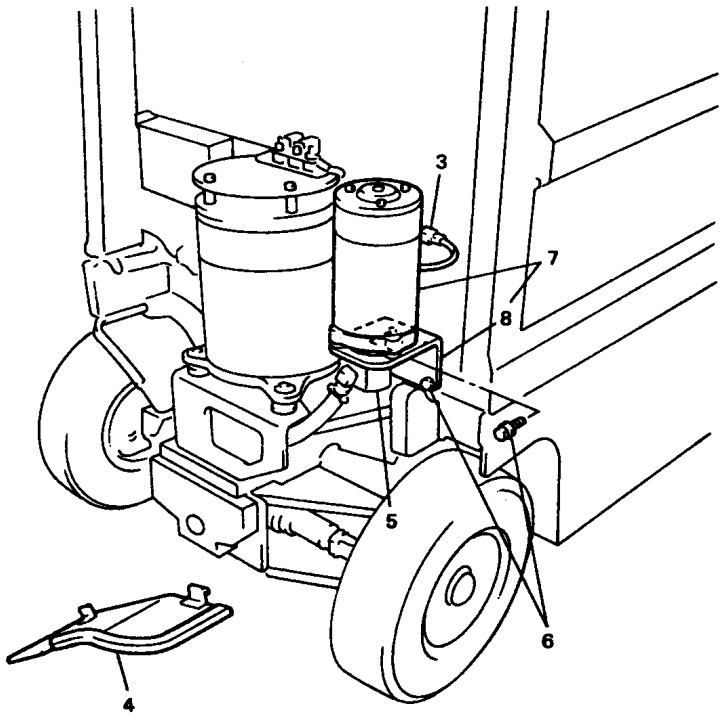
Item \ Model	FBMF16 · 20 · 25 · 30
Type	Permanent magnet type enclosed motor
Nominal voltage V	70
Rated output kW	1.0
Insulation class	F
Brush size (thickness × width × length) mm (in)	Up to 1999.8 : 8 × 30 × 25 (0.31 × 1.18 × 0.98) From 1999.9 : 8 × 20 × 25 (0.31 × 0.79 × 0.98)
Number of brushes	Up to 1999.8 : 2 From 1999.9 : 4
Weight kg (lb)	10 (22)

COMPONENTS

1403



REMOVAL · INSTALLATION



1 Battery plug
2 Counterweight
9 Insulators

Removal Procedure

1 Disconnect the battery plug.

2 Remove the counter weight. (See page 13-6)

3 Disconnect the PS motor connector.

4 Remove the under cover RH.

5 Disconnect the PS pump.

6 Remove the upper set bolts and loosen the lower set bolts.

7 Remove the PS motor W/bracket.

8 Remove the PS motor bracket.

9 Remove the PS motor mounting insulators.

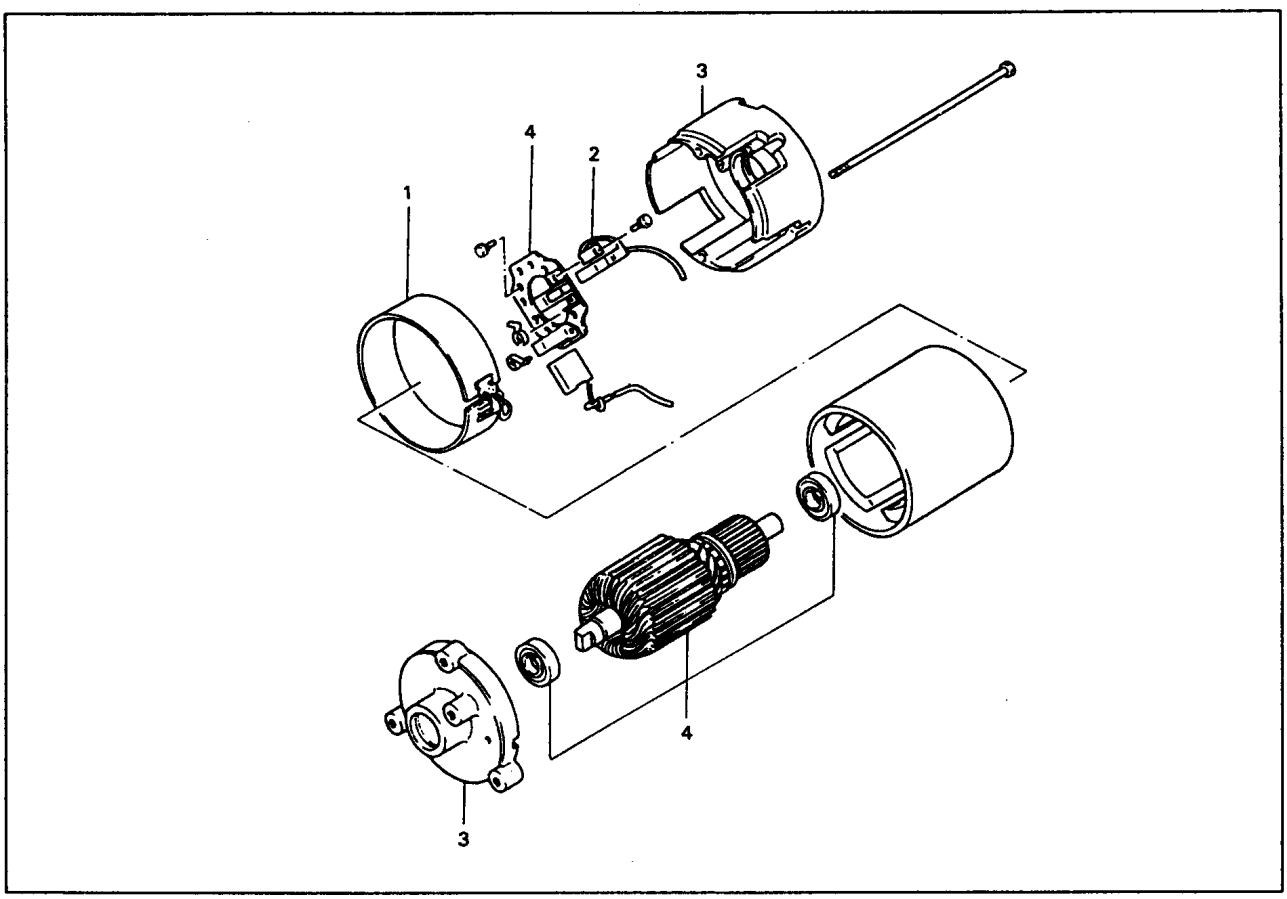
Installation Procedure

The installation procedure is the reverse of the removal procedure.

DISASSEMBLY · INSPECTION · REASSEMBLY

Note:
Measure the insulation resistance between each motor terminal and motor body before disassembly.

Standard: 1 MΩ or more (with a 500 V DC megger)



Disassembly Procedure

1 Remove the brush cover.

2 Set the brushes free.

3 Remove the bracket No.2 and commutator frame. **[Point 1]**

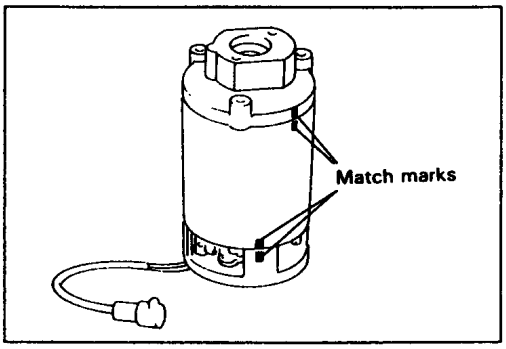
4 Remove the armature coil. **[Point 2]**

5 Remove the brush holder. **[Point 3]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
- **Measure the insulation resistance between each motor cable and motor body.**
  Standard: 1 MΩ or more (with a 500 V DC megger)

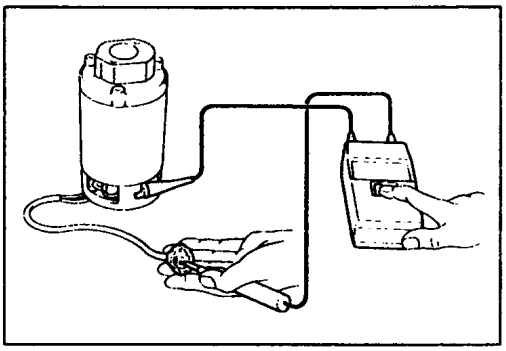


Point Operations

[Point 1]

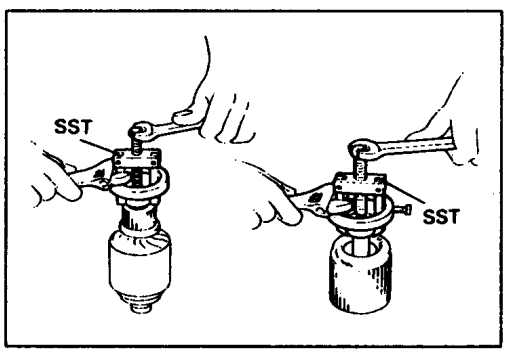
Disassembly: Put match marks on the bracket No. 2 and yoke. (Same for the commutator frame and yoke)

Reassembly: Align the match marks.

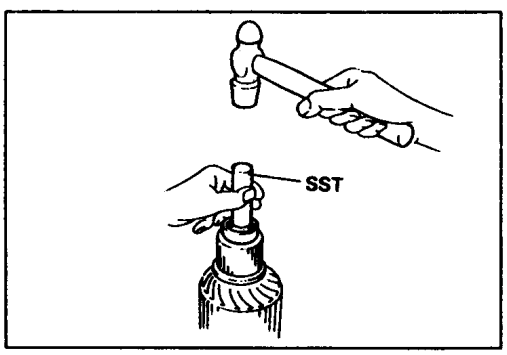


Inspection: After reassembly, measure the insulation resistance between each terminal and motor body.

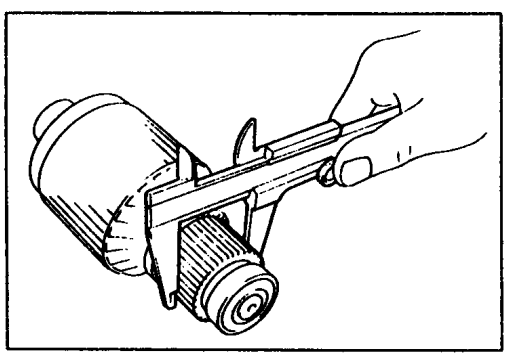
Standard: 1 MΩ or more



[Point 2]
Disassembly: SST 09380-41800-71

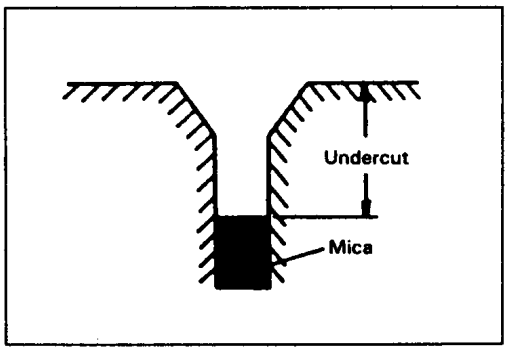


Reassembly: SST 09201-76004-71 (SST 09201-56010)



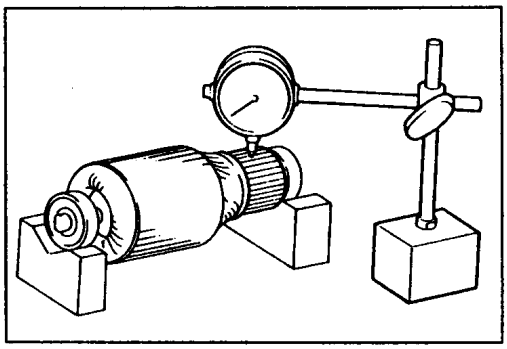
Inspection: If the commutator surface is roughened, clean carefully after correcting with sand-paper (about #600).
If heavily roughened, correct with a lathe.

Commutator outside diameter
Standard: 50 mm (1.97 in)
Limit: 45 mm (1.77 in)



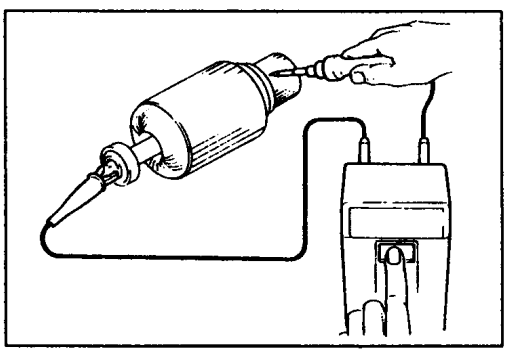
Inspection: Undercut the mica portion when the commutator is corrected.

Undercut
Standard: 0.8 mm (0.031 in)
Limit: 0.3 mm (0.012 in)



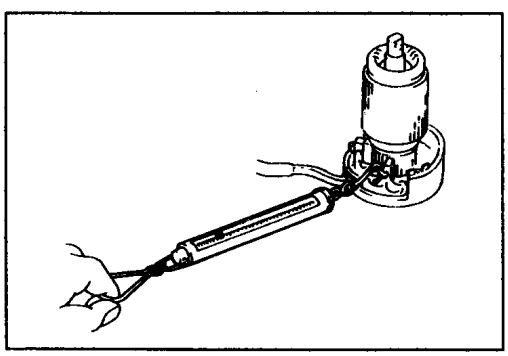
Inspection: Measure the commutator runout.

Standard: 0.03 mm (0.0012 in) or less



Inspection: Measure the armature coil insulation resistance.

Standard: 1 MΩ or more

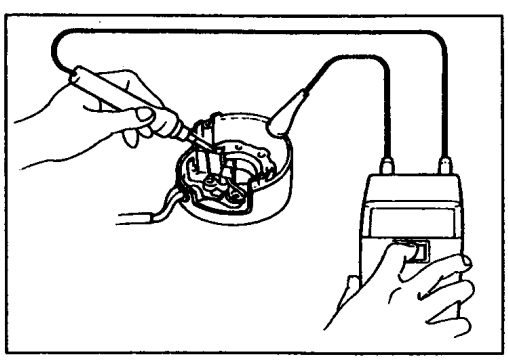


[Point 3]

Inspection: Install the armature and brushes. Set a spring scale on a brush spring and measure the spring force on the instant the spring leaves the brush.

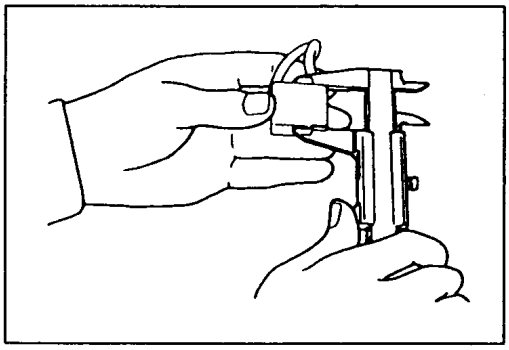
Spring force
Up to 1999.8:
Standard: 5.59 N (0.57 kgf)[1.26 lbf]
Limit: 2.74 N (0.28 kgf)[0.62 lbf]

From 1999.9:
Standard: 4.7 N (0.48 kgf)[1.06 lbf]
Limit: 4.25 N (0.43 kgf)[0.95 lbf]



Inspection: Measure the insulation resistance between the brush holder and bracket.

Standard: 1 MΩ or more



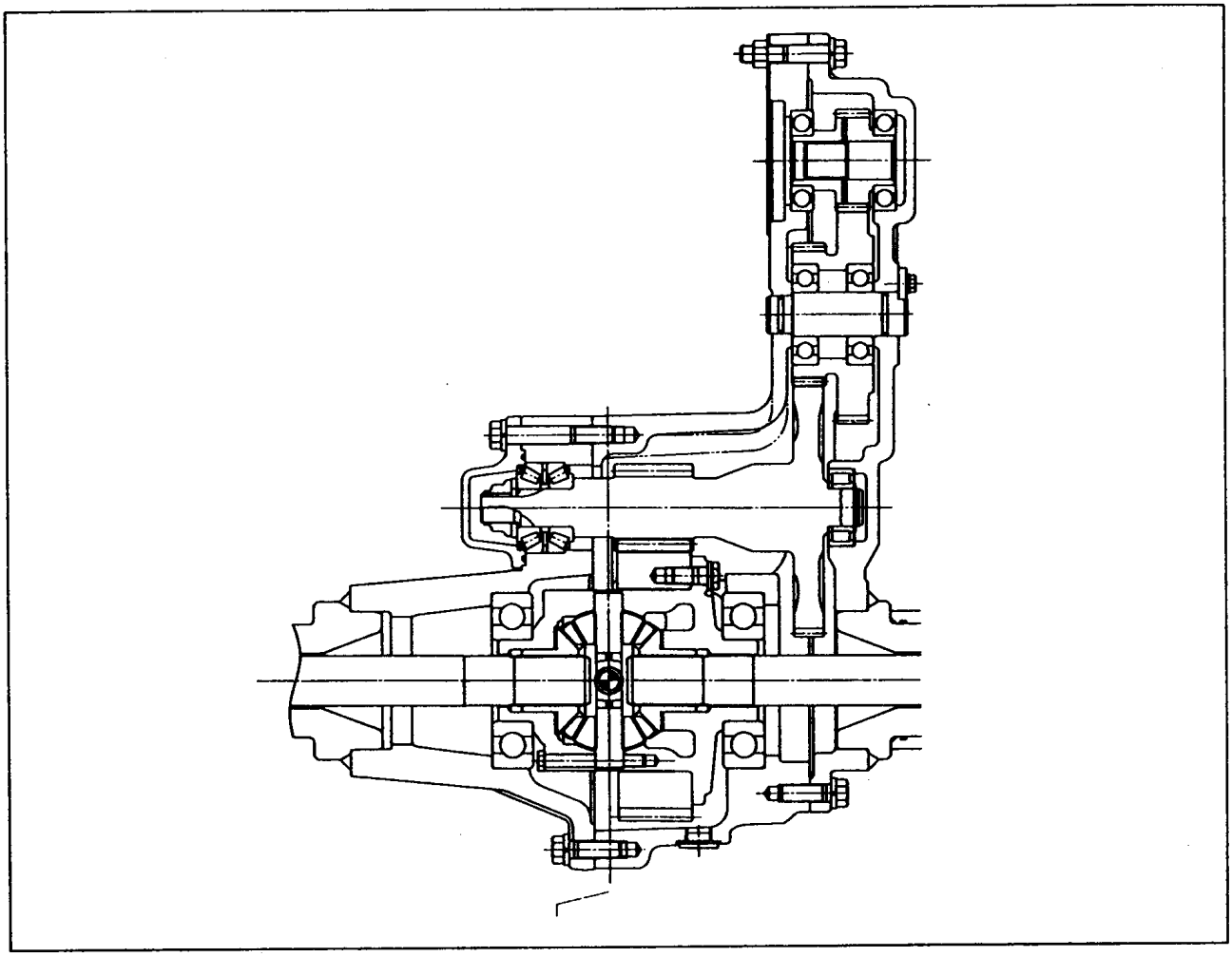
Inspection: Inspect each brush for wear and contact state.

Brush length
Up to 1999.8:
Standard: 25 mm (0.98 in)
Limit: 14 mm (0.55 in)

From 1999.9:
Standard: 25 mm (0.98 in)
Limit: 15 mm (0.59 in)

DRIVE UNIT

GENERAL

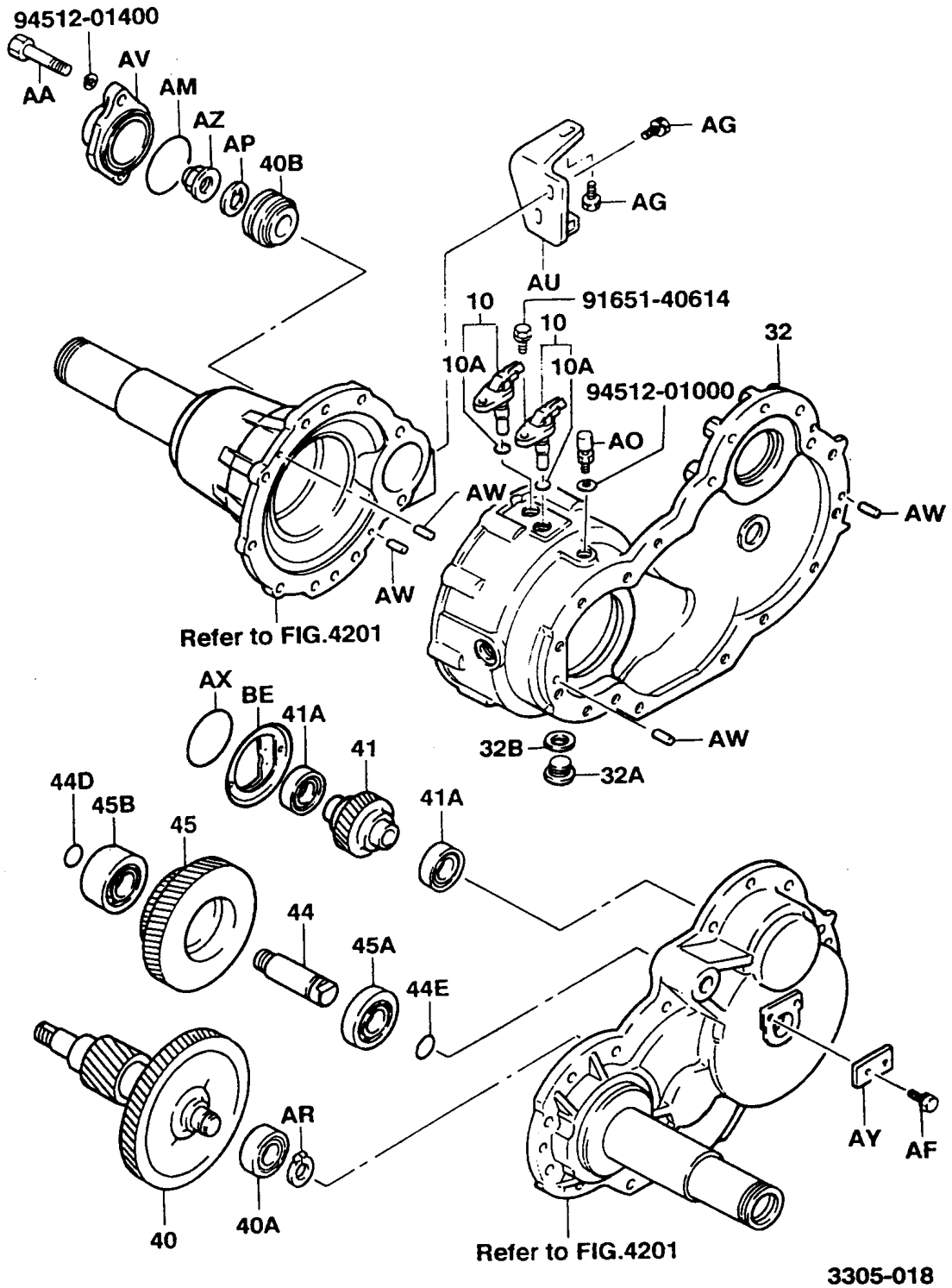


SPECIFICATIONS

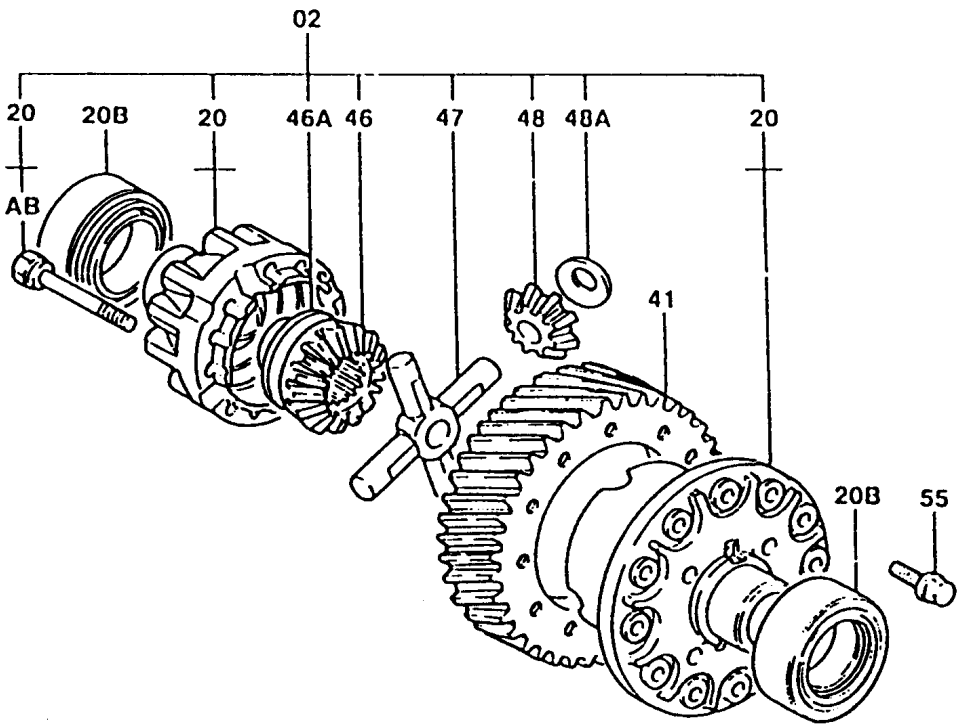
Item \ Model	FBMF16	FBMF20·25	FBMF30
Overall reduction ratio	15.929	←	20.766
Number of drive gear teeth	23	←	19
Number of reduction gear teeth	52/33	←	56/33
Number of output gear teeth	62/12	←	←
Number of ring gear teeth	45	←	←
Drive unit and differential oil volume ℓ (US gal)	5.0 (1.30)	5.5 (1.43)	←

COMPONENTS

3305



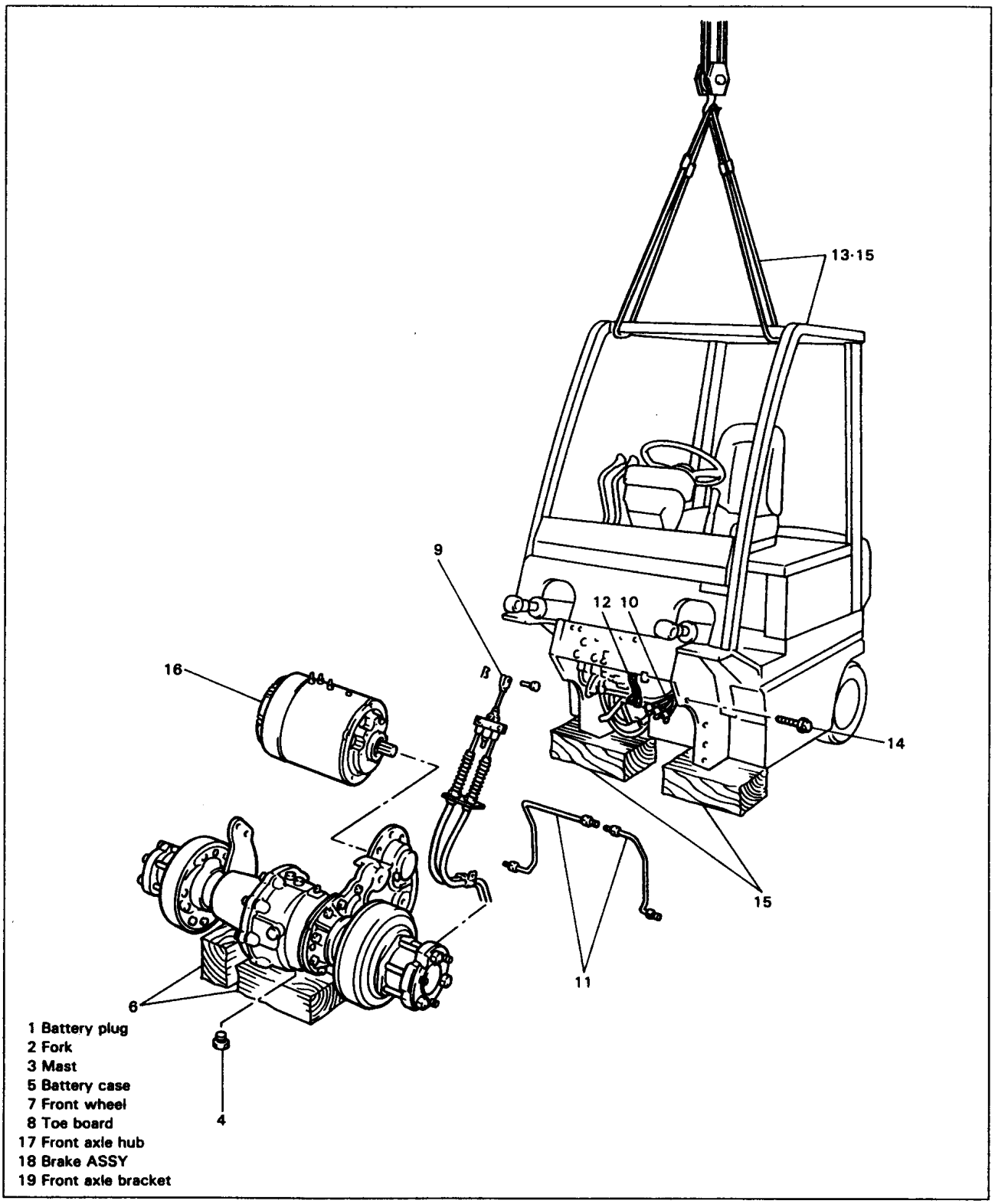
4101



4101-131

DRIVE UNIT

REMOVAL·INSTALLATION



1 Battery plug
2 Fork
3 Mast
5 Battery case
7 Front wheel
8 Toe board
17 Front axle hub
18 Brake ASSY
19 Front axle bracket

Removal Procedure

1 Disconnect the battery plug.

2 Remove the fork. (See page 15-18)

3 Remove the mast ASSY W/lift bracket. (See page 15-5)

4 Drain differential oil.

5 Remove the battery case. (See page 3-5)

6 Support the front axle ASSY with wooden blocks. **[Point 1]**

7 Remove the front wheels. **[Point 2]**

8 Remove the toe board.

9 Disconnect the parking brake cable and cable clamp.

10 Disconnect the drive motor cables and clamps.

11 After draining the brake oil, remove the brake pipes.

12 Disconnect the speed sensor connectors. **[Point 3]**

13 Slightly hoist the front of the vehicle.

14 Remove the front axle bracket set bolts. **[Point 4]**

15 Carefully move it in the reverse direction.

16 Remove the drive motor. (See page 7-4)

17 Remove the front axle hub. (See page 9-7)

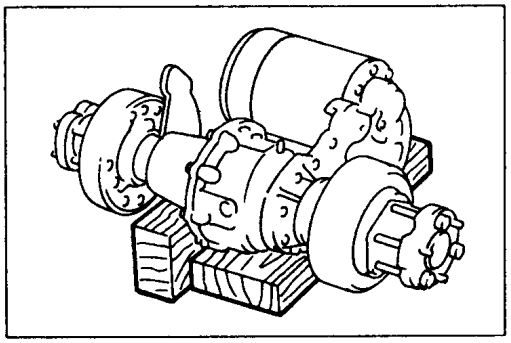
18 Remove the brake ASSY.

19 Remove the front axle bracket.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
The tightening torque for each portion is as follows:
Front axle bracket set bolt: 235.2 ~ 294.0 N·m (2400 ~ 3000 kgf-cm) [173.64 ~ 217.05 ft-lbf]

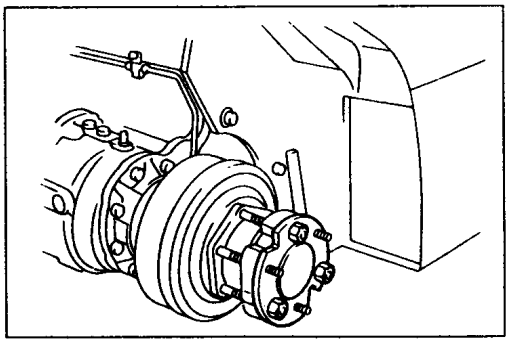


Point Operations

[Point 1]

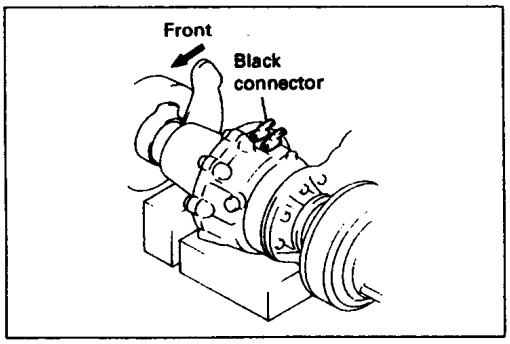
Removal·Installation: Support the front axle ASSY with wooden blocks.

CAUTION:
- **Pay sufficient attention to the stability when the front axle ASSY is removed from the frame.**
- **When removing the drive motor, do not support the motor body portion with a wooden block.**



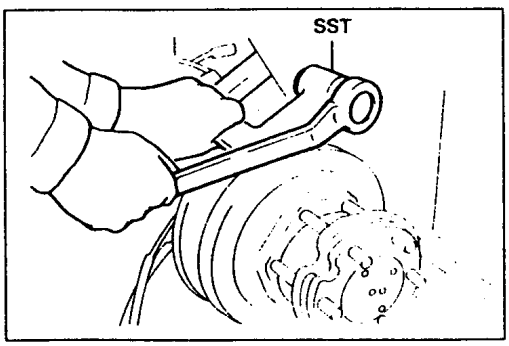
[Point 2]

Removal: FBMF16 only
If axle shaft removal is unnecessary, temporarily install hub nuts to prevent the axle shaft from coming off.



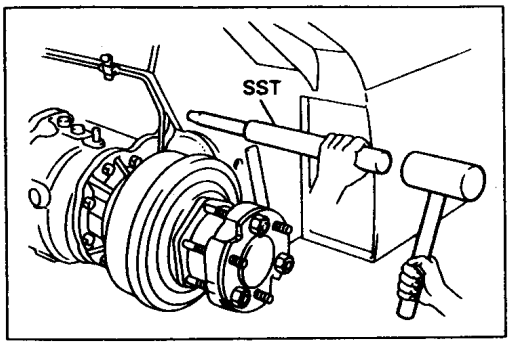
[Point 3]

Installation: Connect the vehicle speed sensor connector so that the black connector is positioned in the center of the frame (on the right side).



[Point 4]

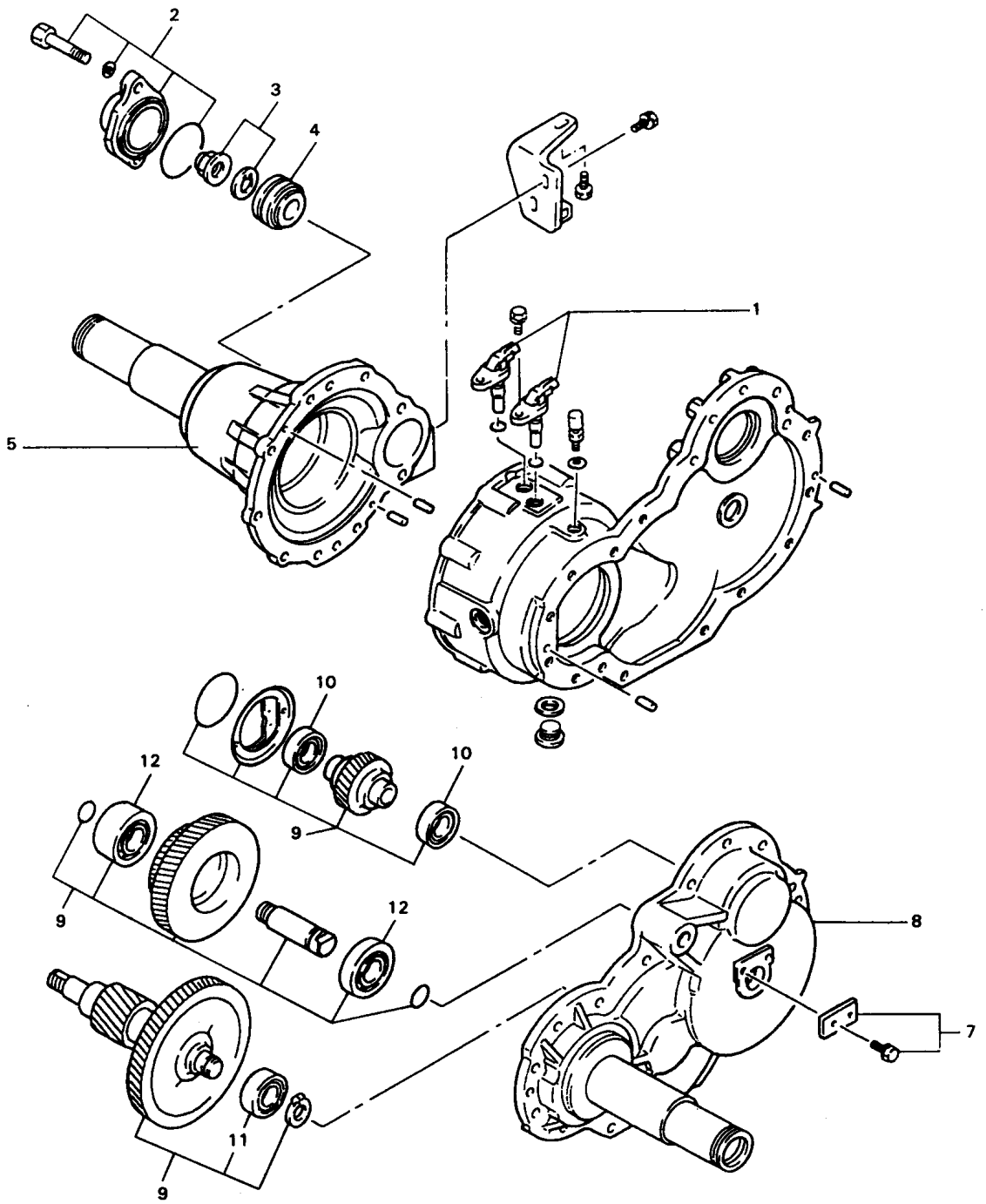
Removal: Using SST, remove the four reamer bolts.
SST 09310-22000-71



Installation: Using SST, align the bolt holes.
SST 09360-10410-71

DRIVE GEARS

DISASSEMBLY·INSPECTION·REASSEMBLY



6 Differential ASSY

Disassembly Procedure

1 Remove the two pick up sensors.

2 Remove the drive unit cap.

3 Remove the drive gear lock nut. **[Point 1]**

4 Remove the tapered roller bearing. **[Point 2]**

5 Remove the front axle housing RH. **[Point 3]**

6 Remove the differential ASSY.

7 Remove the reduction gear key plate.

8 Remove the front axle housing LH. **[Point 4]**

9 Remove the drive gear, reduction gear and output gear.

10 Remove the drive gear bearing. **[Point 5]**

11 Remove the bearings from the output gear. **[Point 6]**

12 Remove the bearings from the reduction gear. **[Point 7]**

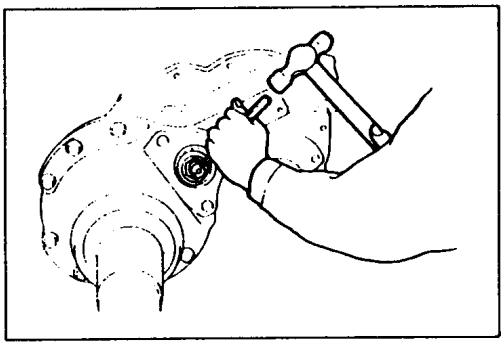
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
•The tightening torque for each portion is as follows:

Unit: T = N·m (kgf-cm) [ft-lbf]

Front axle housing LH set bolt	60.8 ~ 113.7 (620 ~ 1160) [44.9 ~ 83.9]
Front axle housing RH set bolt	60.8 ~ 113.7 (620 ~ 1160) [44.9 ~ 83.9]
Out put gear lock nut	167 ~ 226 (1700 ~ 2300) [123 ~ 166]
Drive unit cap set bolt	60.8 ~ 113.7 (620 ~ 1160) [44.9 ~ 83.9]

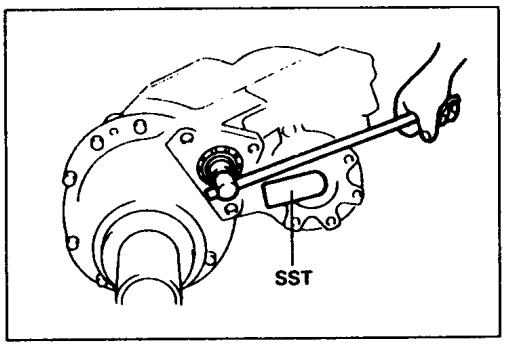


Point Operations

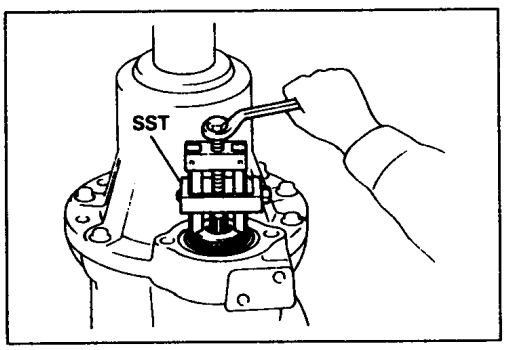
[Point 1]

Disassembly: Using a chisel, unstake the nut.

Reassembly: Using a punch, stake the nut.

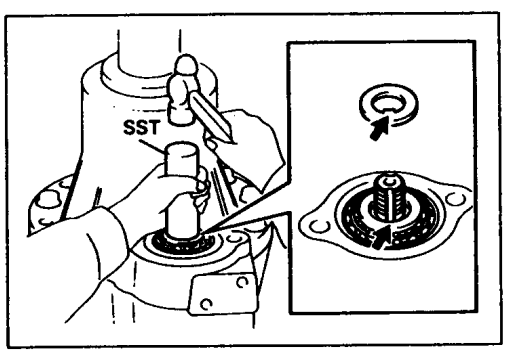


Disassembly·Reassembly: SST 09330-13200-71

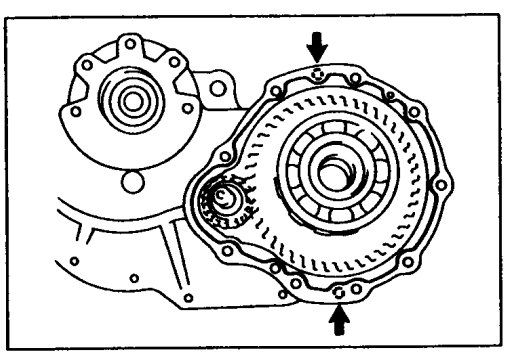


[Point 2]

Disassembly:
1. Remove the washer.
2. Using SST, remove the tapered roller bearing.
   SST 09556-76001-71 (SST 09556-22010)



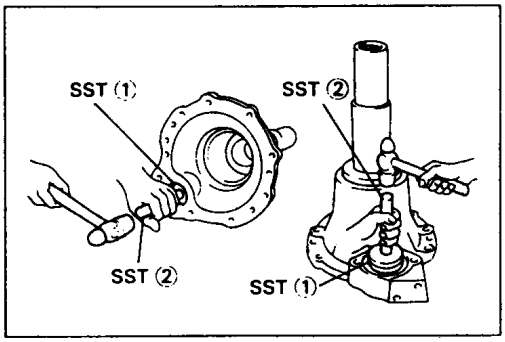
Reassembly:
1. Using SST, temporarily install the tapered roller bearing.
   SST 09608-04031
2. Install the washer, as shown.



[Point 3]

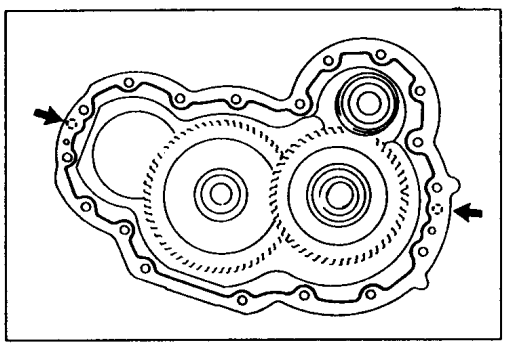
Disassembly: Use two service bolts for disassembly.
Service bolt size: M14 × 1.5

Reassembly: Coat liquid gasket on the gear case matching surface before reassembly.
Gasket: 08826-76002-71 (08826-00090)



Disassembly: Using SST, remove the bearing outer races and spacer.
SST 09950-76018-71 (SST 09950-60010)····①
SST 09950-76020-71 (SST 09950-70010)····②

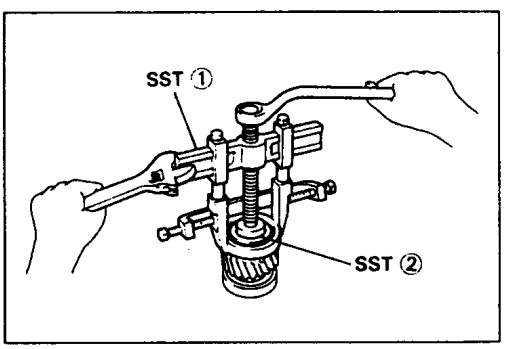
Reassembly: Using SST, install the bearing outer races and spacer.
SST 09950-76018-71 (SST 09950-60010)····①
SST 09950-76020-71 (SST 09950-70010)····②



[Point 4]

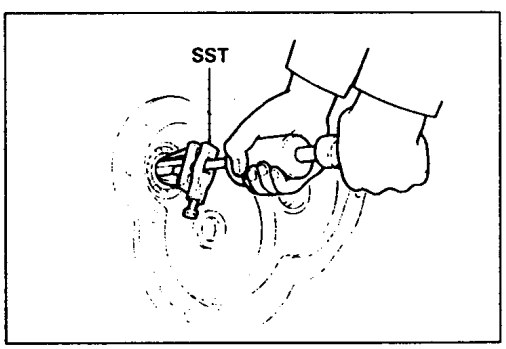
Disassembly: Use two service bolts for disassembly.
Service bolt size: M14 × 1.5

Reassembly: Coat liquid gasket on the gear case matching surface before reassembly.
Gasket: 08826-00090

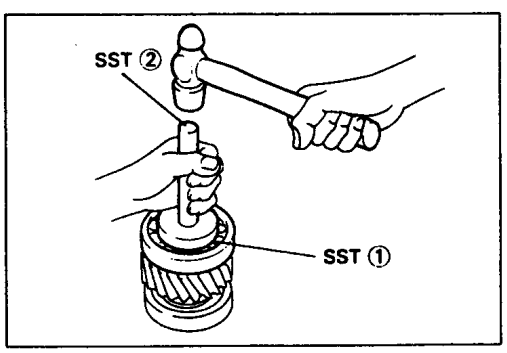


[Point 5]

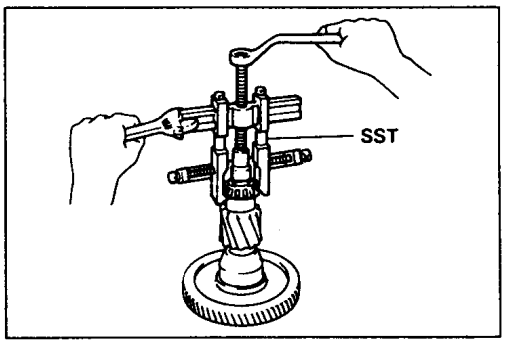
Disassembly: Using SST, remove the bearings.
SST 09950-76004-71 (SST 09950-40011)····①
SST 09950-76018-71 (SST 09950-60010)····②



If the drive gear bearing remains in the axle housing LH:
SST 09308-10010

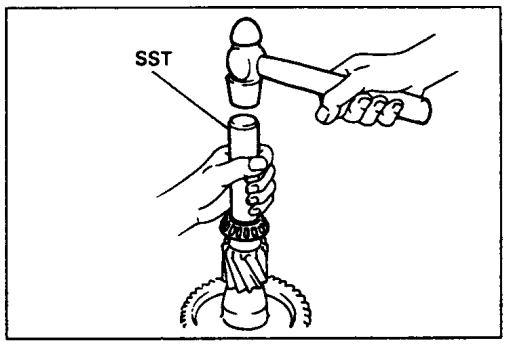


Reassembly: SST 09950-76018-71 (SST 09950-60010)····①
SST 09950-76020-71 (SST 09950-70010)····②

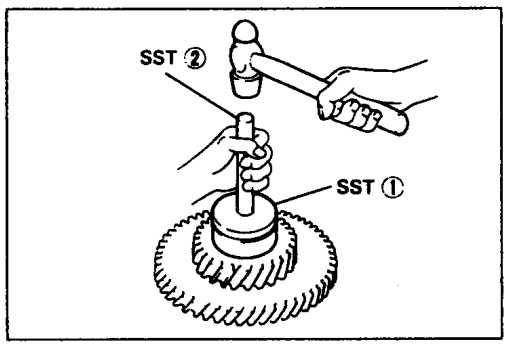


[Point 6]

Disassembly: Using SST, remove the tapered roller bearing.
SST 09950-76014-71 (SST 09950-40011)



Reassembly: Using SST, install the tapered roller bearing.
SST 09608-76003-71 (SST 09608-04031)



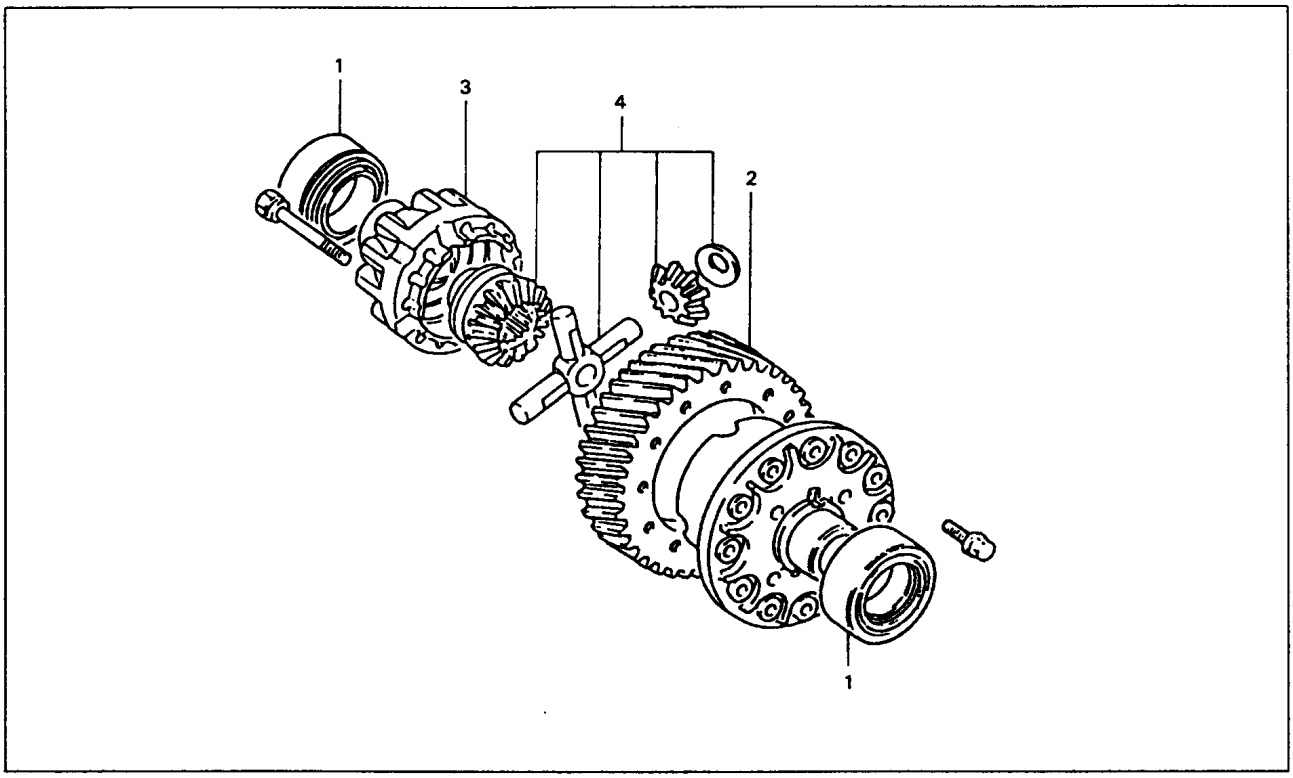
[Point 7]

Disassembly: Using a brass bar, remove the bearing.

Reassembly: Using SST, install the bearing.
SST 09950-76018-71 (SST 09950-60010)····①
SST 09950-76020-71 (SST 09950-70010)····②

DIFFERENTIAL

DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

1 Remove the differential case bearings. **[Point 1]**

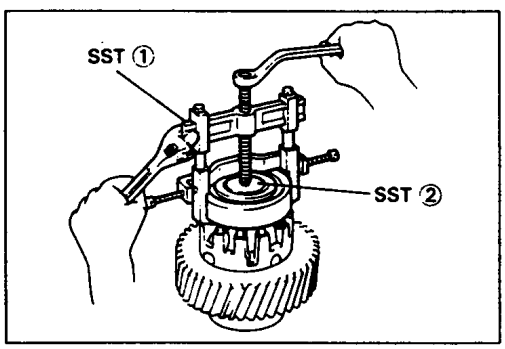
2 Remove the ring gear. **[Point 2]**

3 Remove the RH differential case. **[Point 3]**

4 Remove the side gears, pinion gears, spider and thrust washers. **[Point 4]**

Reassembly Procedure

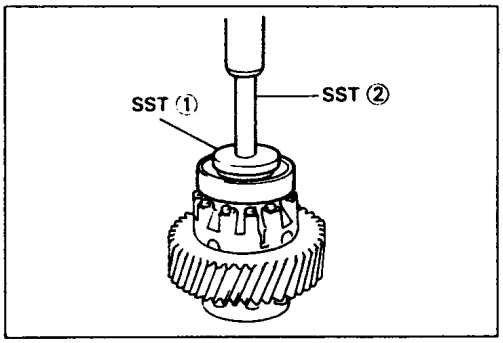
The reassembly procedure is the reverse of the disassembly procedure.



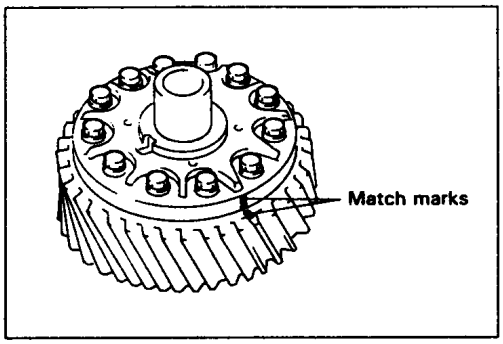
Point Operations

[Point 1]

Disassembly: SST 09950-76014-71 (SST 09950-40011)····①
SST 09950-76018-71 (SST 09950-60010)····②



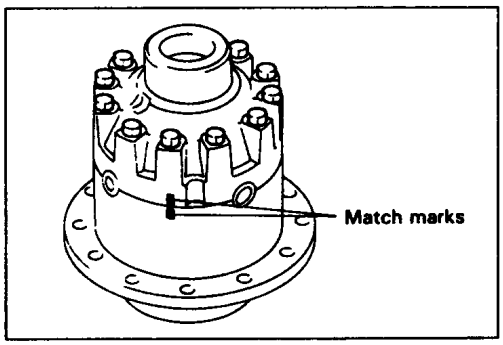
Reassembly: SST 09950-76018-71 (SST 09950-60010)····①
SST 09950-76020-71 (SST 09950-70010)····②



[Point 2]

Disassembly: Punch match marks on the ring gear and LH differential case.

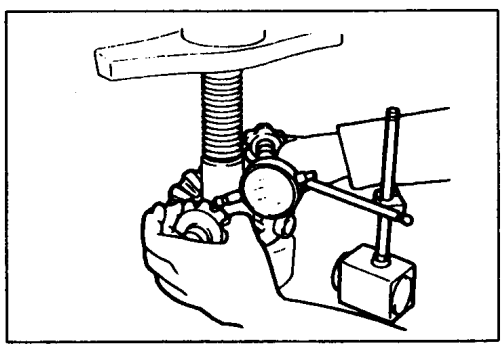
Reassembly: Align the match marks.



[Point 3]

Disassembly: Punch match marks on the RH and LH differential cases.

Reassembly: Align the match marks.

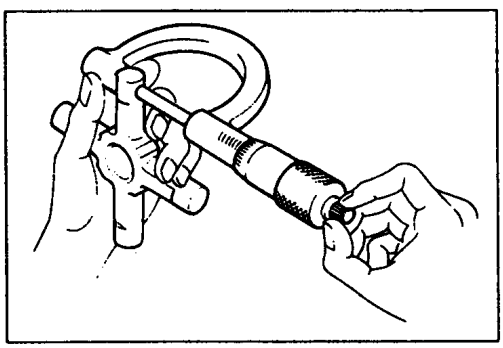


[Point 4]

Inspection: Measure the backlash between the side gear and pinion gear.
Install the side gear and pinion gear on the case. Lightly push the spider to bring pinion gear and side gear close to the thrust washer for measurement.

Backlash:
0.2 ~ 0.3 mm (0.008 ~ 0.012 in)

Measure the backlash at both cases.



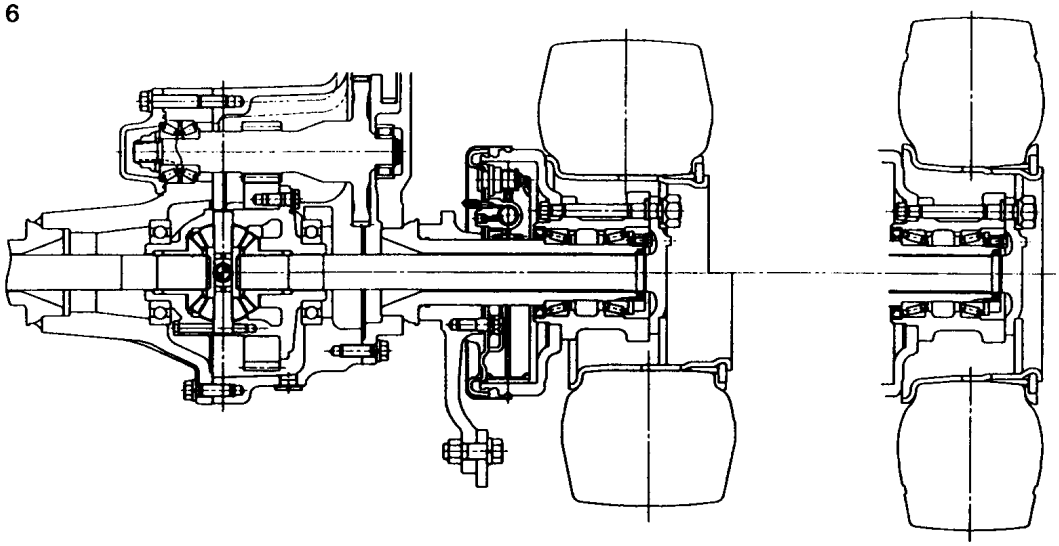
Inspection: Measure the spider outside diameter.

Standard: 22.00 mm (0.8661 in)
Limit: 21.75 mm (0.8563 in)

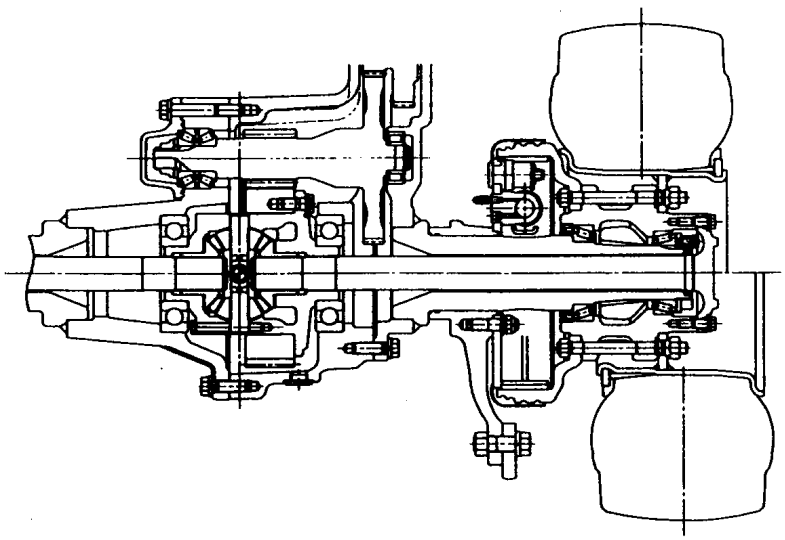
FRONT AXLE

GENERAL

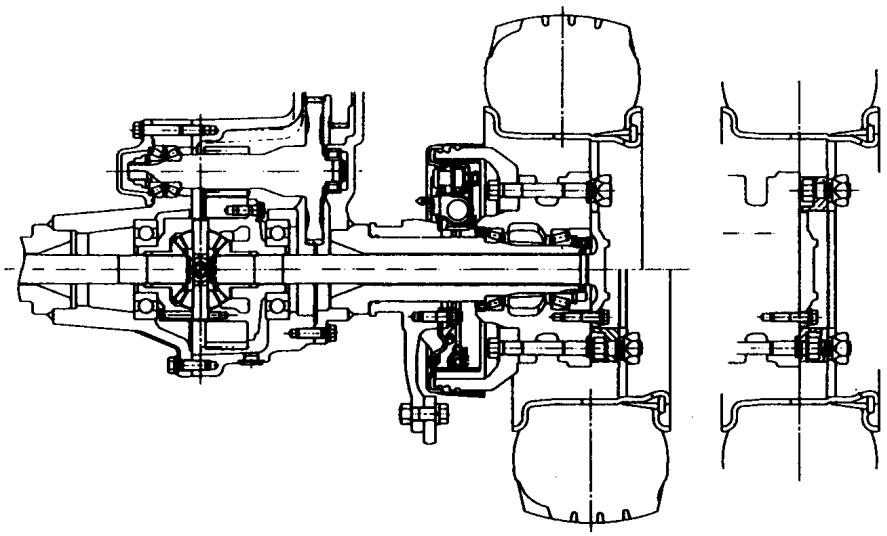
FBMF16



FBMF20·25



FBMF30



SPECIFICATIONS

Item \ Model		FBMF16	FBMF20·25	FBMF30
Front axle type		Full-floating	←	←
Suspension type		Fixed to frame	←	←
Axle shaft diameter mm (in)		40 (1.57)	←	←
Axle shaft diameter (spline portion) mm (in)		40 (1.57)	←	←
Wheel (STD)	Tire size	21 × 8 – 9	23 × 9 – 10	28 × 9 – 15
	Rim size	9 × 6.00E	10 × 6.50F	15 × 7.00T

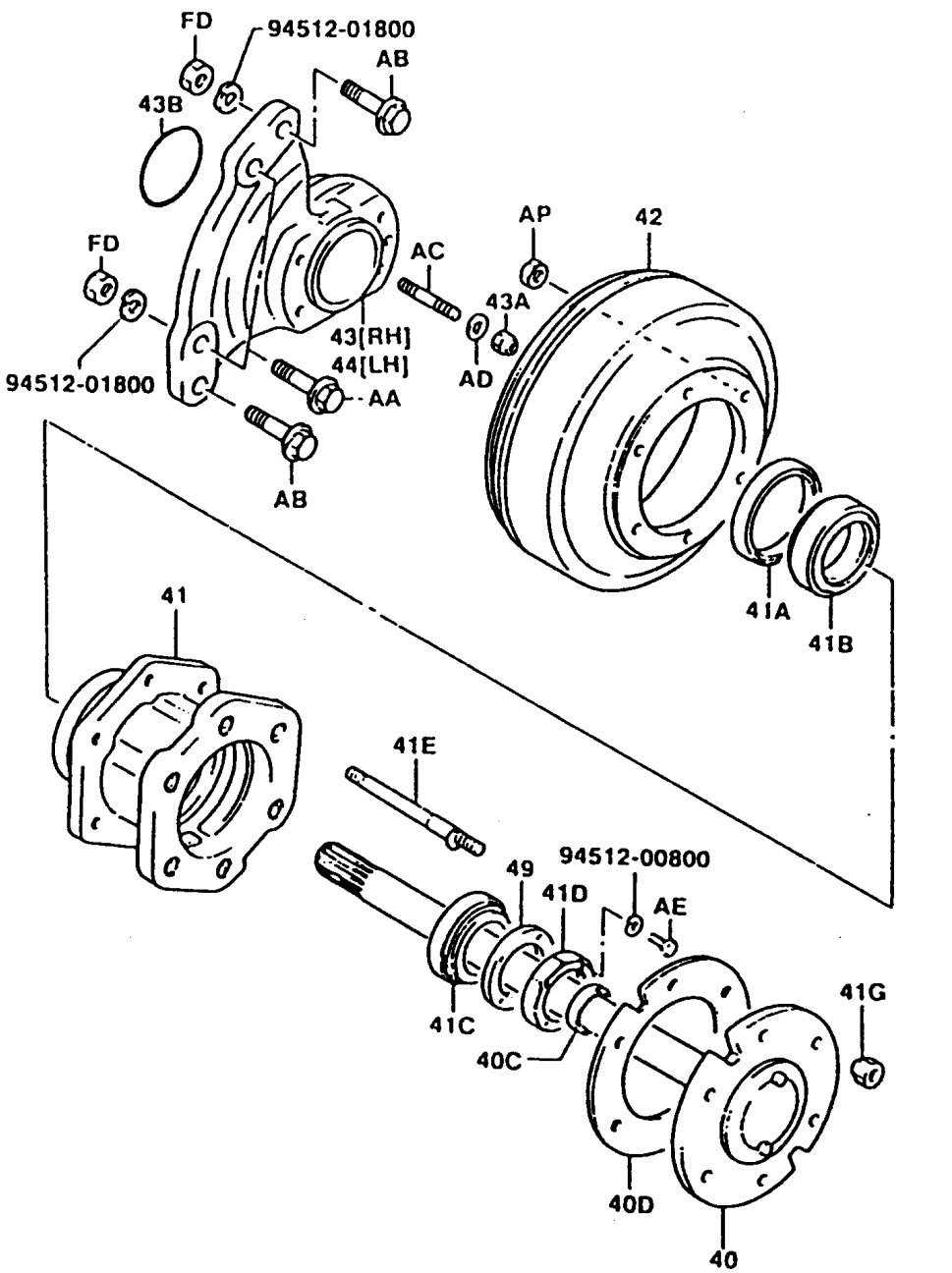
Tire inflating pressure

Model	Type	Rim size	Pneumatic shaped cushion tire	Pneumatic tire	Inflating pressure kPa (kgf/cm²) [psi]
FBMF16	Standard	9 × 6.00E TB	21 × 8 – 9	21 × 8 – 9 – 14PR	883 (9.0) [128]
	Over size	10 × 5.00F TB	6.50 – 10	6.50 – 10 – 12PR	
	Wide tread	9 × 6.00E TB	21 × 8 – 9	21 × 8 – 9 – 14PR	
FBMF20·25	Standard	10 × 6.50F TB	23 × 9 – 10	23 × 9 – 10 – 18PR	883 (9.0) [128]
	Wide tread				
FBMF30	Standard	15×7.00T IR	28 × 9 – 15	—	—
		15 × 7.00S SDC			
	Wide tread	15 × 7.00T IR	—	28 × 9 – 15 – 14PR	785 (8.0) [114]
		15 × 7.00S SDC			

COMPONENTS

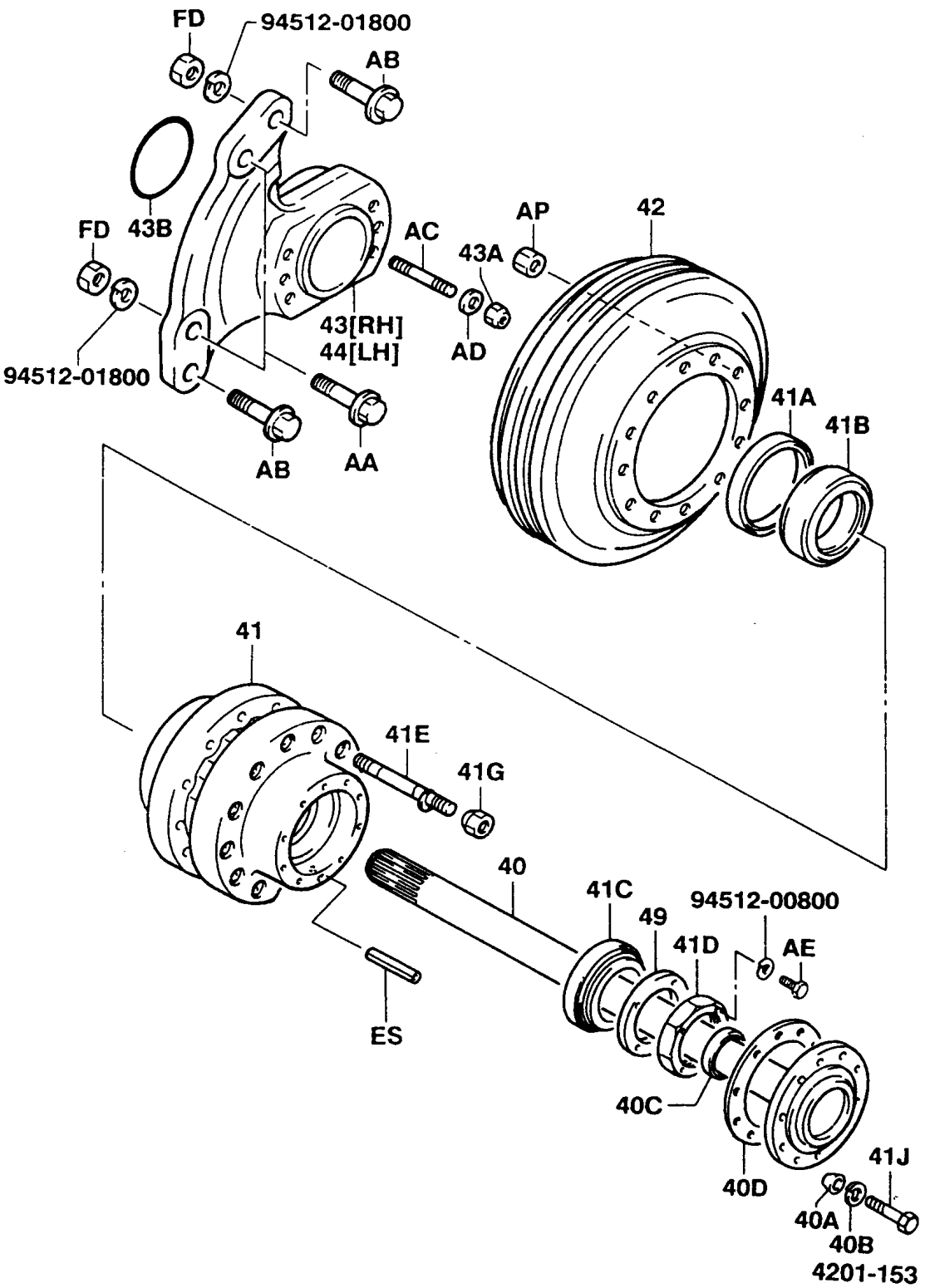
FBMF16

4201



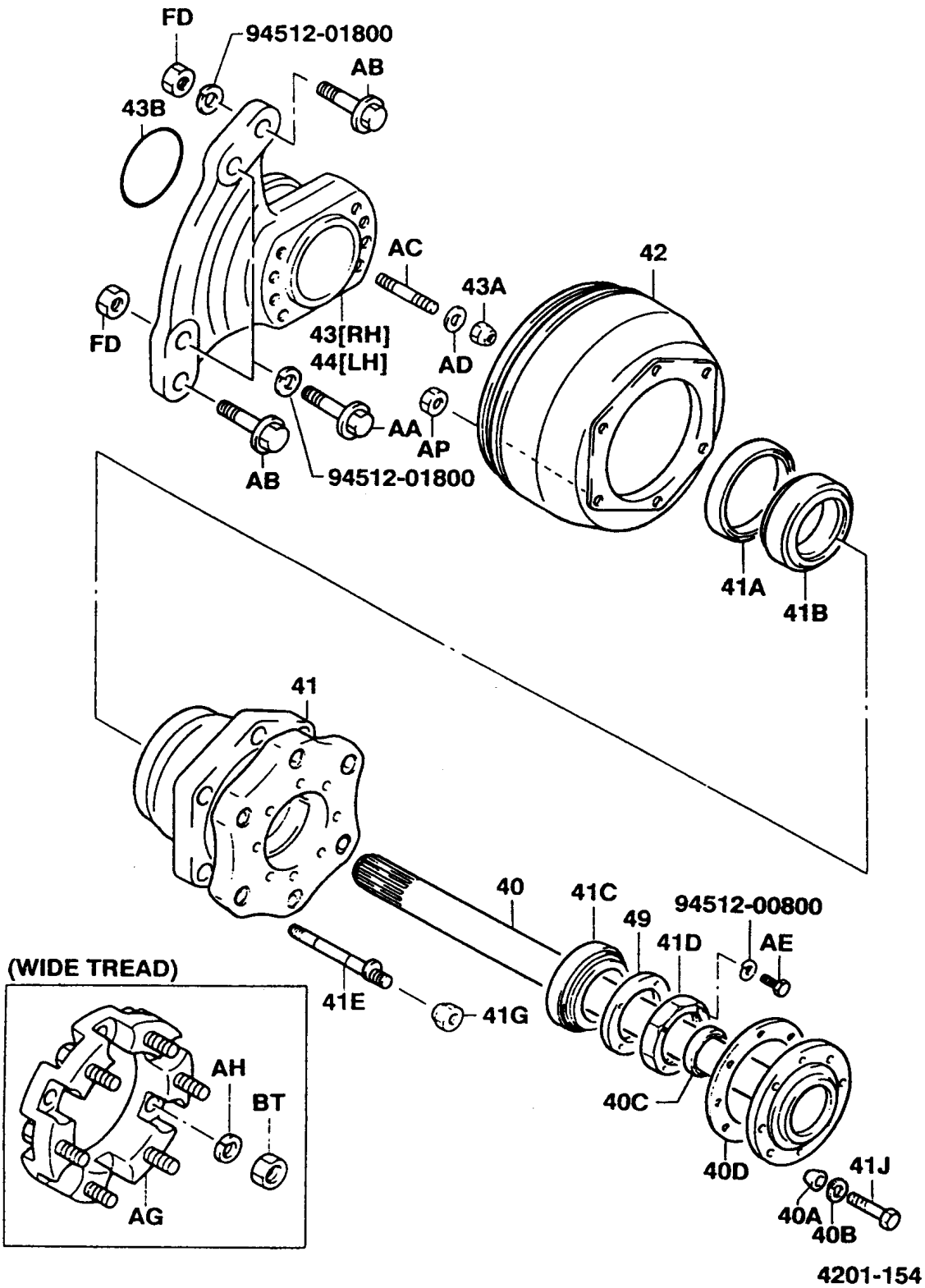
FBMF20·25

4201



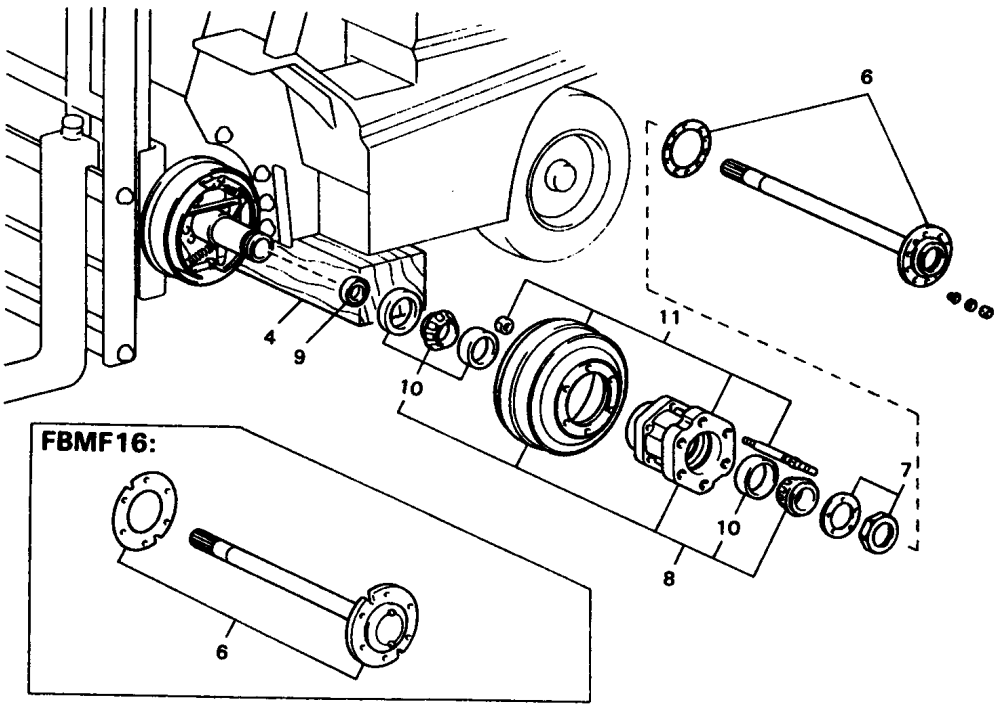
FBMF30

4201


FD
94512-01800
AB
43B
AC
42
43A
FD
43[RH]
44[LH]
AD
AA
AP
AB
94512-01800
41A
41B
41
40
41C
49
94512-00800
41D
AE
41E
41G
(WIDE TREAD)
AH
BT
AG
40C
40D
41J
40A
40B
4201-154

FRONT AXLE SHAFT·HUB

REMOVAL·INSTALLATION



1 Drive unit and differential oil
2 Rear wheel
3 Front wheel hub nut
5 Front wheels

Removal Procedure

1 Drain differential oil.
2 Chock the rear wheels.
3 Loosen the front wheel hub nuts.
4 Jack up the frame and support its bottom with a stand or wooden blocks.
5 Remove the front wheels.
6 Remove the axle shaft. **[Point 1]**
7 Remove the bearing lock nut and lock nut plate. **[Point 2]**
8 Remove the front axle hub W/brake drum. **[Point 3]**
9 Remove the axle shaft oil seal. **[Point 4]**
10 Remove the hub oil seal and bearing. **[Point 5]**
11 Disconnect the brake drum. **[Point 6]**

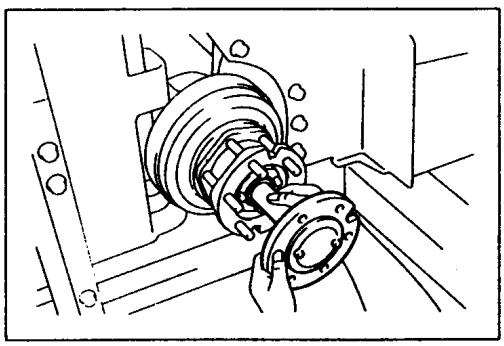
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
- **Coat thread tightener (08833-00070) on the brake drum set nut before tightening.**
- **Adjust the braking performance after installation. Make the vehicle travel in the forward and reverse directions about 10 times and depress the brake pedal to stop the vehicle each time.**
- **The tightening torque for each portion is as follows:**

Unit: N·m (kgf-cm) [ft-lbf]

Brake drum set nut (hub bolt set nut)	FBMF16: FBMF20·25: FBMF30:	68.65 ~ 88.26 (700 ~ 900) [50.65 ~ 86.82] 78.45 ~ 107.87 (800 ~ 1100) [57.88 ~ 79.59] 168.71 ~ 205.94 (1700 ~ 2100) [123.00 ~ 151.94]
Bearing lock nut stopper bolt		14.71 ~ 21.57 (150 ~ 220) [10.85 ~ 15.92]
Axle shaft set bolt	FBMF20·25: FBMF30:	68.65 ~ 88.26 (700 ~ 900) [50.65 ~ 86.82] 98.07 ~ 127.49 (1000 ~ 1200) [72.35 ~ 94.06]
Hub nut	FBMF16: FBMF20·25: FBMF30:	176.52 ~ 392.27 (1800 ~ 4000) [130.23 ~ 289.40] 107.87 ~ 196.13 (1100 ~ 2000) [79.59 ~ 144.70] 294.20 ~ 588.40 (3000 ~ 6000) [217.05 ~ 434.10]

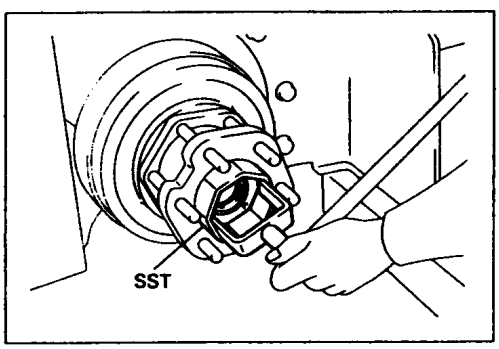


Point Operations

[Point 1]

Removal: After removing the axle shaft set bolts (except FBMF16), lightly tap the center of the axle shaft flange with a copper hammer for easy removal.

Removal·installation: Carefully operate so as not to damage the oil seal.

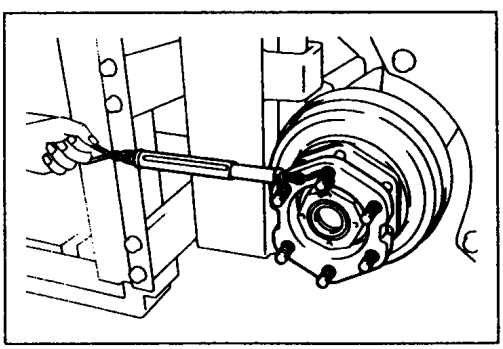


[Point 2]

Removal·installation:
SST 09509-76002-71 (SST 09509-55020)

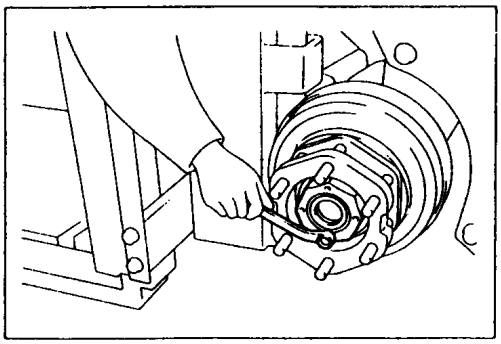
Installation: Adjust the front axle bearing starting torque.

1. Fully tighten the bearing lock nut, rotate the hub by 4 to 5 turns. Then loosen the lock nut by 1/12 to 1/6 turn and rotate the hub by 4 to 5 turns again.

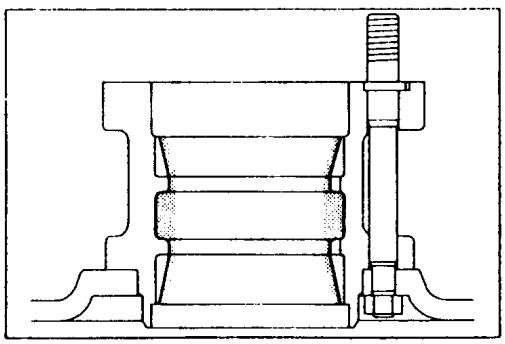


2. Set a spring scale on the hub bolt and measure the starting force.

   Starting force
   24.5 ~ 44.1 N (2.5 ~ 4.5 kgf) [18.1 ~ 32.6 lbf]

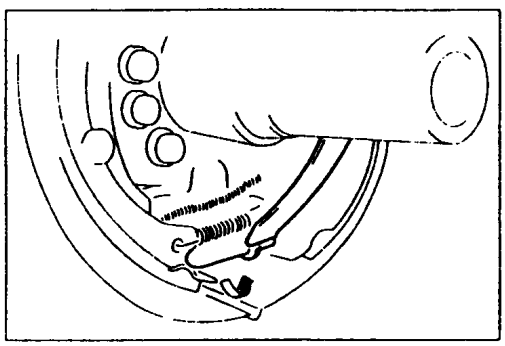


3. If the measured value does not satisfy the standard above, make adjustment by tightening or loosening the lock nut.
4. Align the lock nut plate stopper hole with the lock nut threaded hole.
5. Coat thread tightener (08833-00070) on the lock nut stopper bolt, and tighten it.

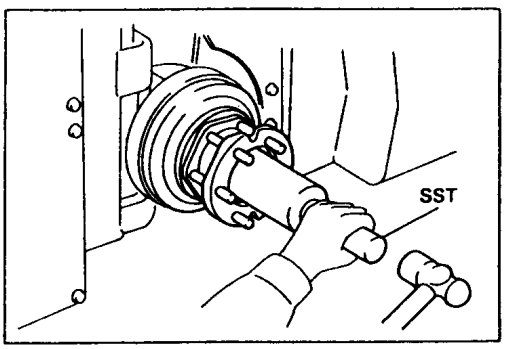


[Point 3]

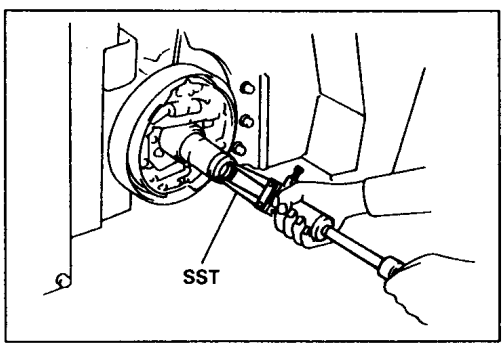
Installation: **Fill MP grease in the hub and bearings before installing the front axle hub W/brake drum.**



Installation: Turn the brake auto adjuster screw to contract the brake shoe slightly for easier brake drum installation.

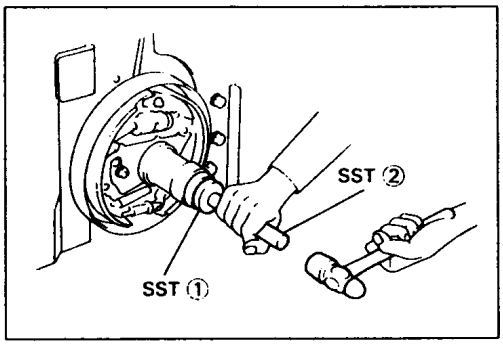


Installation: SST 09370-10410-71



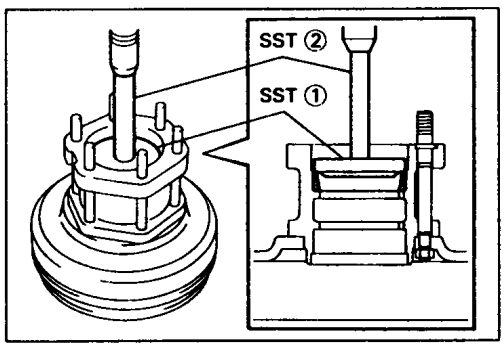
[Point 4]

Removal: SST 09308-76001-71 (SST 09308-00010)



Installation: SST 09950-76018-71 (SST 09950-60010)....①
SST 09950-76020-71 (SST 09950-70010)....②

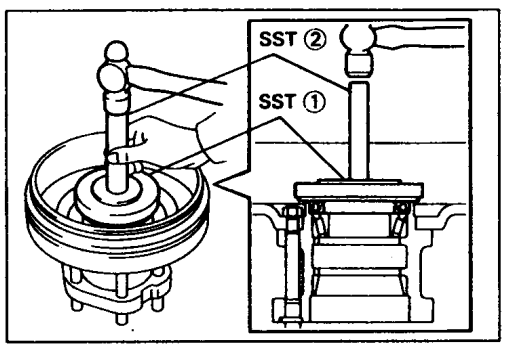
Coat MP grease on the oil seal lip.



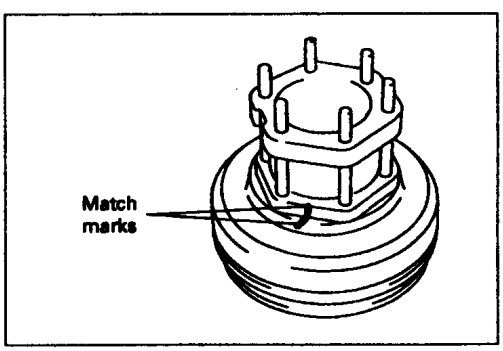
[Point 5]

Removal: Using a brass bar, remove the bearing outer races.

Installation: Using SST, install new bearing outer races.
FBMF16·FBMF20, 25 outside:
SST 09410-30020-71 .....①
SST 09950-76020-71 (SST 09950-70010)....②
FBMF20, 25 inside·FBMF30 outside:
SST 09519-76001-71 (SST 09519-25010)....①
SST 09950-76020-71 (SST 09950-70010)....②
FBMF30 inside:
SST 09223-76002-71 (SST 09223-15030)....①
SST 09950-76020-71 (SST 09950-70010)....②



Installation: Using SST, install a new oil seal.
SST 09340-10410-71 .....①
SST 09950-76020-71 (SST 09950-70010)....②
After installation, coat MP grease on the oil seal lip.



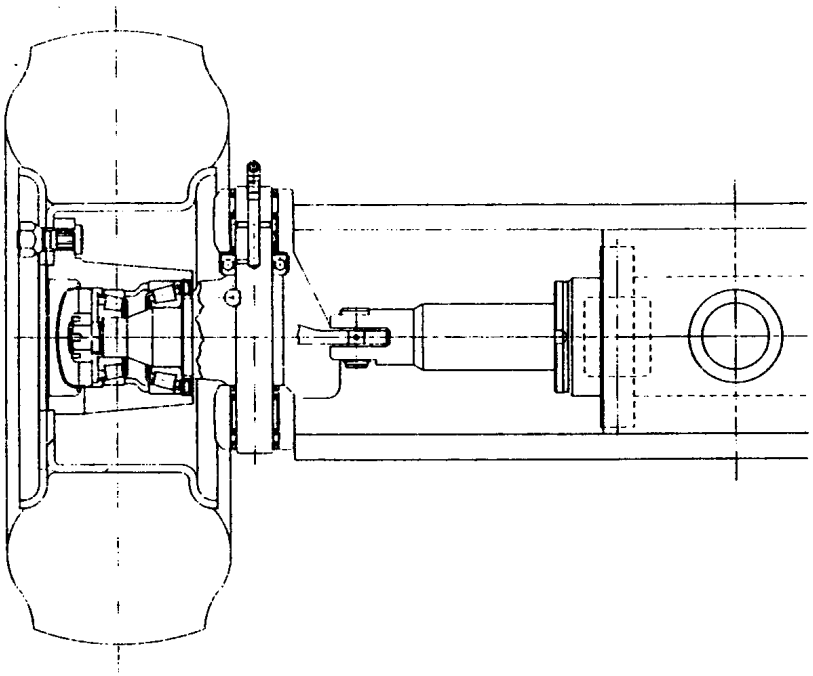
[Point 6]
Removal: Put match marks on the axle hub and brake drum.

Installation: Align the match marks.

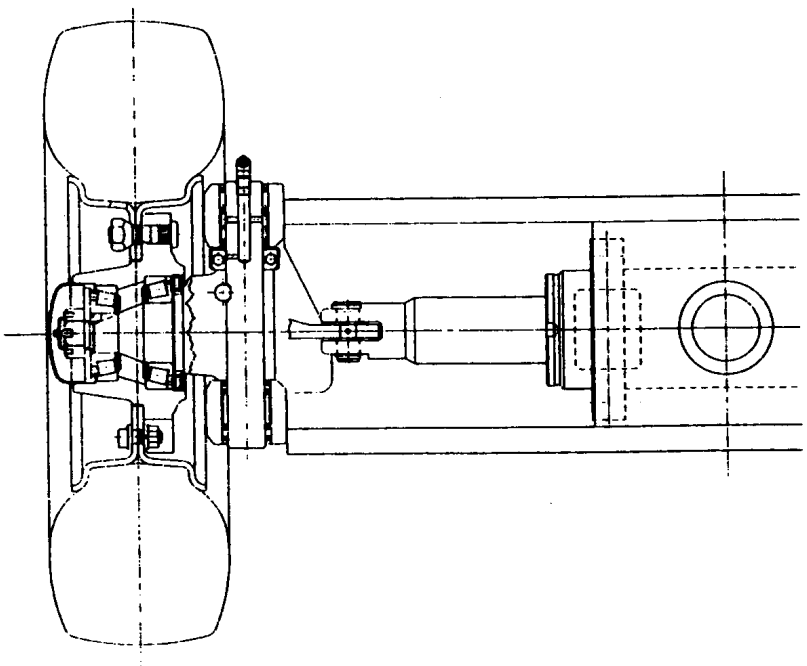
REAR AXLE
(Up to May 1999)

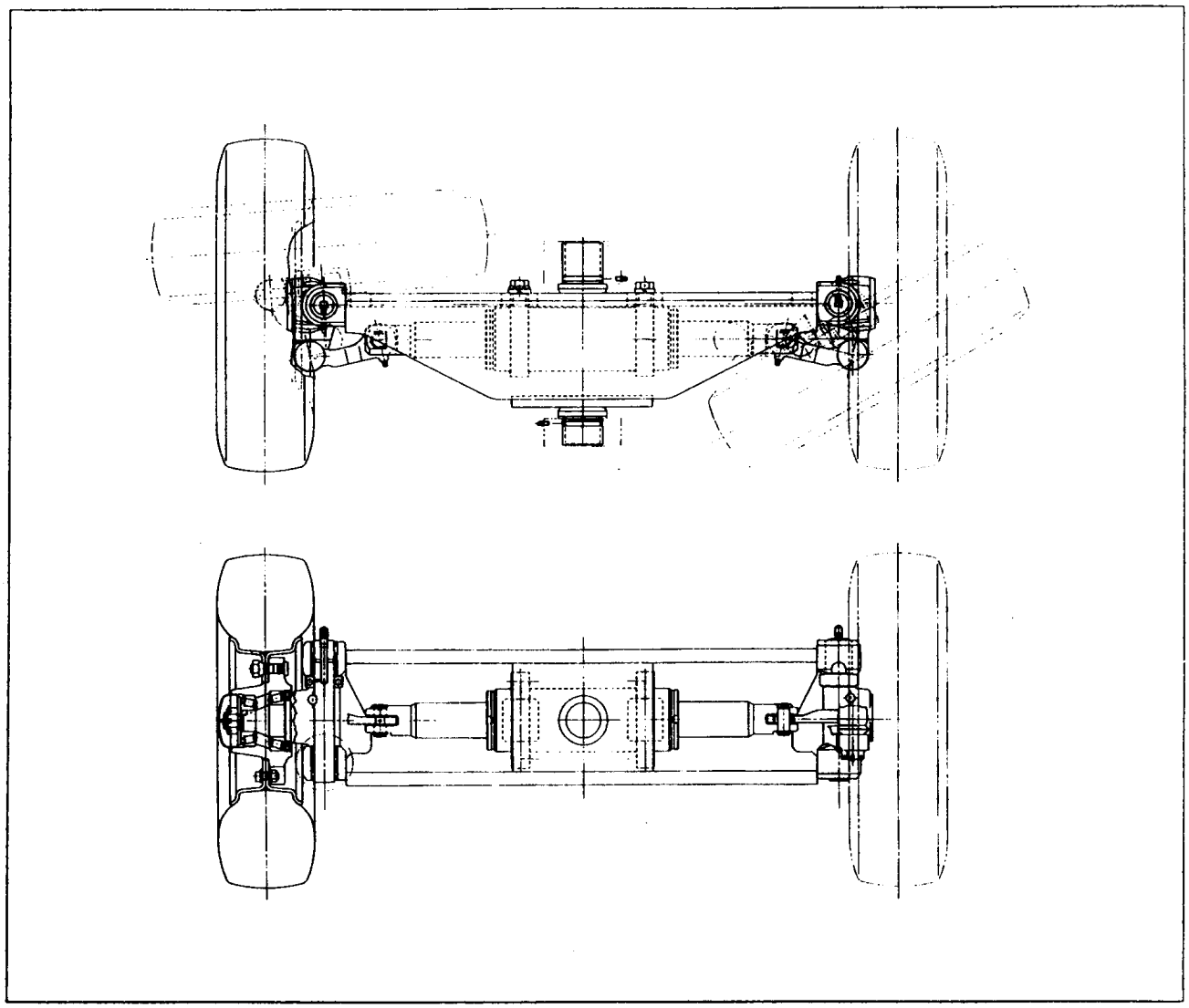
GENERAL

FBMF16

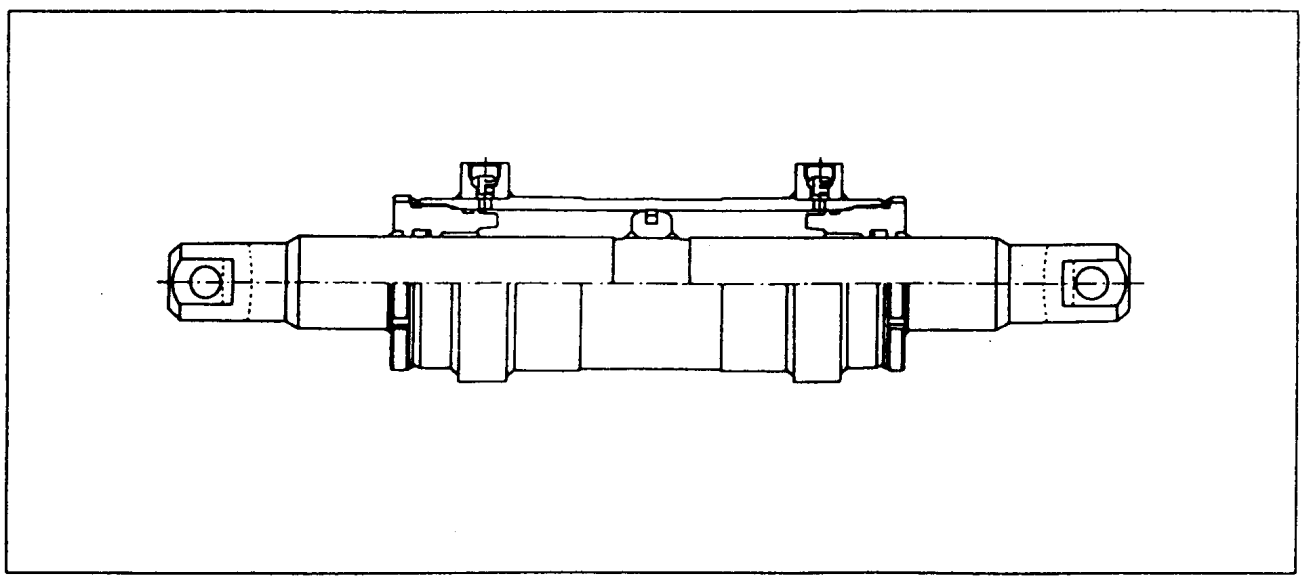


FBMF20·25·30





Rear Axle Cylinder



SPECIFICATIONS

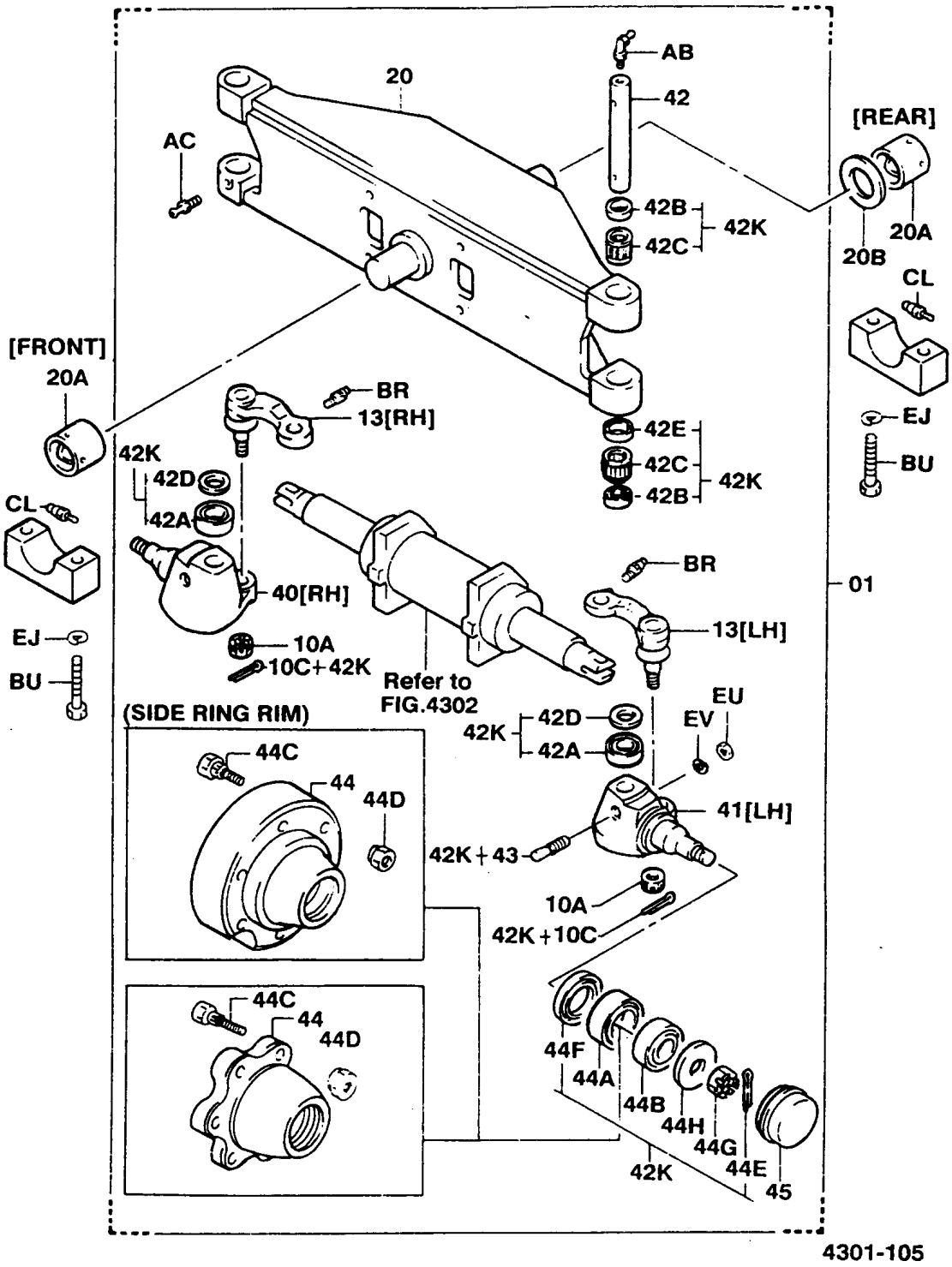
Item \ Model		FBMF16	FBMF20·25	FBMF30
Rear axle type		Elliot type		
Rear axle suspension type		Center-supported right-left rocking type		
Wheel alignment	Toe-in mm (in)	0 (0)		
	Camber degree	0°		
	Caster degree	0°		
	King pin angle	0°		
Minimum turning radius (outermost) mm (in)		1800 (71)	FBMF20: 1960 (77) FBMF25: 1980 (78)	2130 (84)
Wheel (STD)	Tire size	5.00 – 8	18 × 7 – 8	←
	Rim size	8 × 3.00D	8 × 4.25	8 × 4.33R
Rear axle cylinder	Cylinder type	Double acting	←	←
	Cylinder bore mm (in)	75 (2.95)	←	←
	Piston rod outside diameter mm (in)	50 (1.97)	←	←

Tire inflating pressure

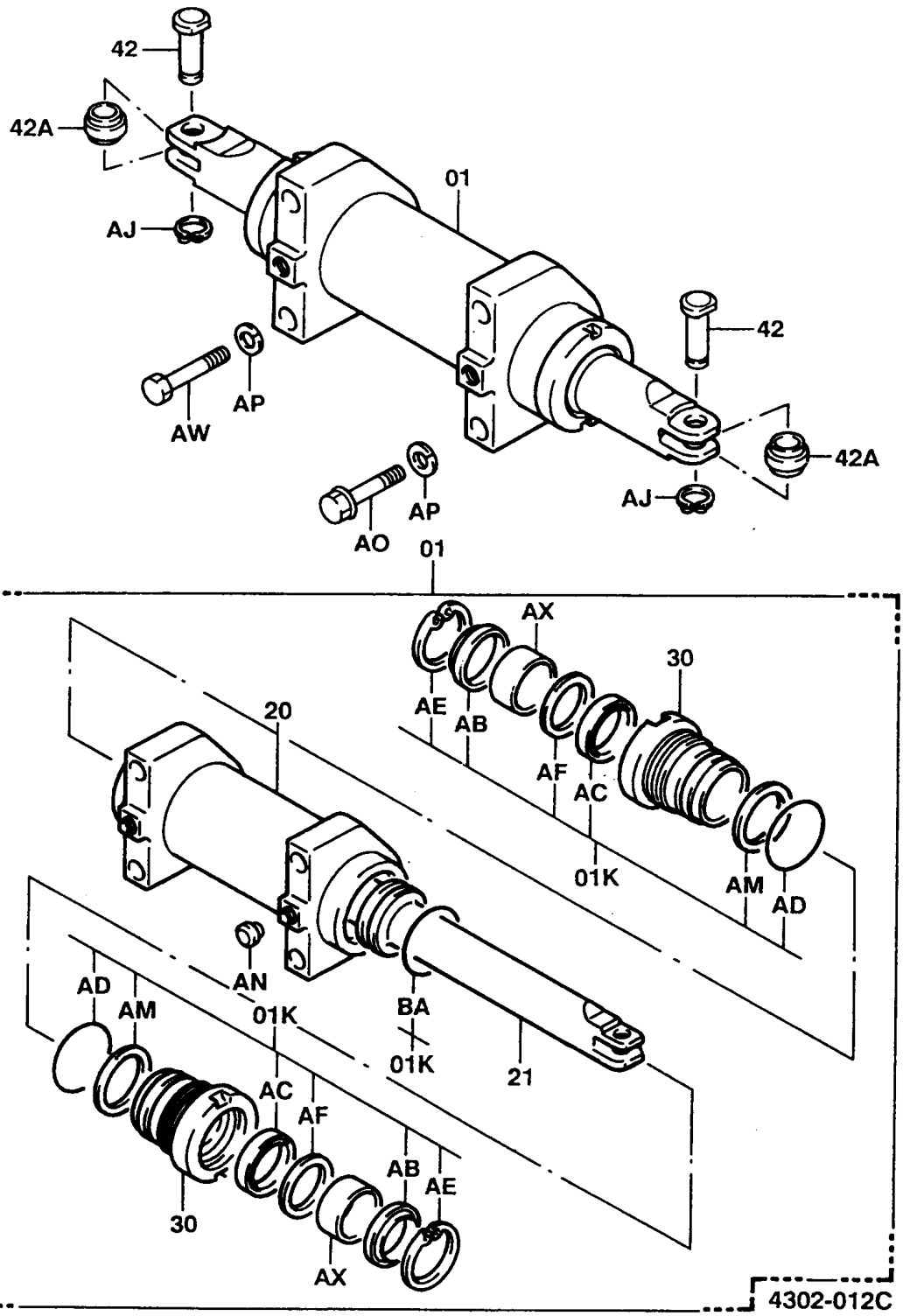
Model	Rim type	Rim size	Pneumatic shaped cushion tire	Pneumatic tire	Inflating pressure kPa (kgf/cm²) [psi]
FBMF16	Devided	8 × 3.00D DT	5.00 – 8	5.00 – 8 – 8PR	785 (8.0) [114]
	Side ring	8 × 3.00D TB			
FBMF20·25	Devided	8 × 4.25 DT	18 × 7 – 8	18 × 7 – 8 – 16PR	690 (7.0) [100] 880 (9.0) [128]
	Side ring	8 × 4.33R TB			
FBMF30	Side ring	8 × 4.33R TB	18 × 7 – 8	18 × 7 – 8 – 16PR	880 (9.0) [128]

COMPONENTS

4301



4302


42
42A
AJ
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AW
AP
AO
AP
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42A
AJ
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AX
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AE
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01K
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21
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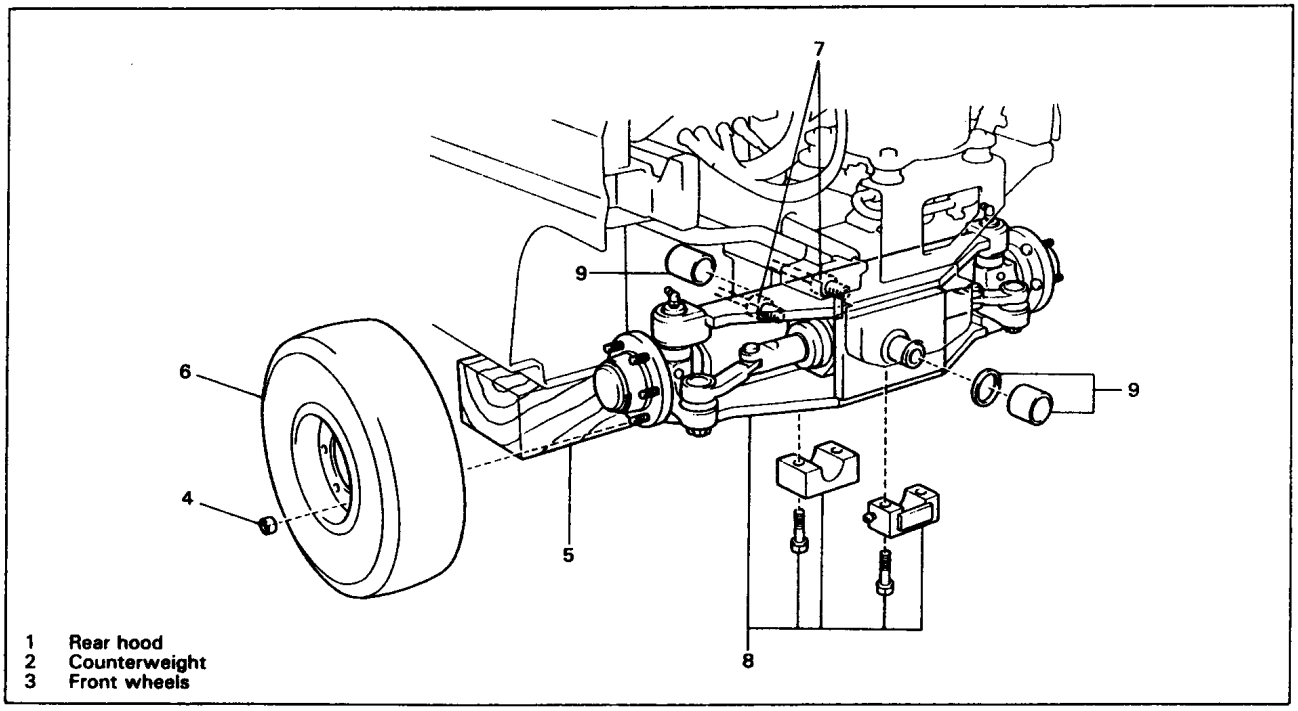
4302-012C

REAR AXLE ASSY

REMOVAL·INSTALLATION



1 Rear hood
2 Counterweight
3 Front wheels

Removal Procedure

1 Open the rear hood.

2 Remove the counterweight.

3 Chock the front wheels.

4 Loosen the rear wheel hub nuts.

5 Jack up the frame and support it with a stand or wooden blocks.

6 Remove the rear wheels.

7 Disconnect the rear axle cylinder hoses.

8 Remove the rear axle ASSY while supporting it with a jack. **[Point 1]**

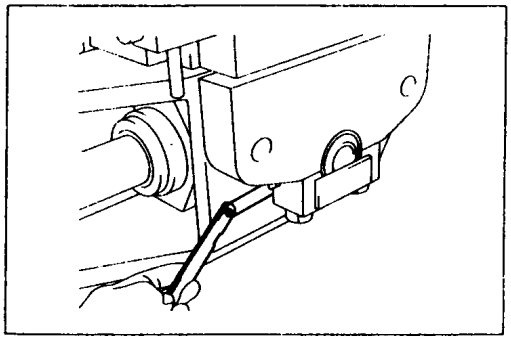
9 Remove the rear axle center pin bushing. **[Point 2]**

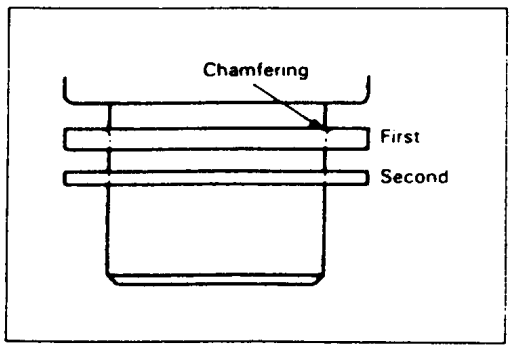
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
- **Supply grease through each grease fitting after installation.**
- **The tightening torque for each portion is as follows:**

Axle bracket cap set bolt: T = 117.68 ~ 166.71 N·m (1200 ~ 1700 kgf-cm) [86.82 ~ 123.00 ft-lbf]
Hub nut: See page 10-10.





Point Operations

[Point 1]

Inspection: Measure the rear axle front to rear clearance.

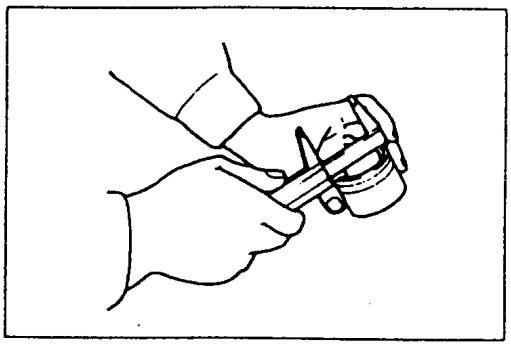
1. Before removing the rear axle ASSY, measure the front to rear clearance on the rear side.

   Standard clearance: 0.5 mm (0.020 in) or less

2. If the measured value does not satisfy the standard, remove the rear axle ASSY and make adjustment by changing the spacer.

   Spacer thickness:
   3.0·3.5·4.0·4.5·5.0 and 5.5 mm
   (0.118·0.138·0.157·0.177·0.197 and 0.217 in)

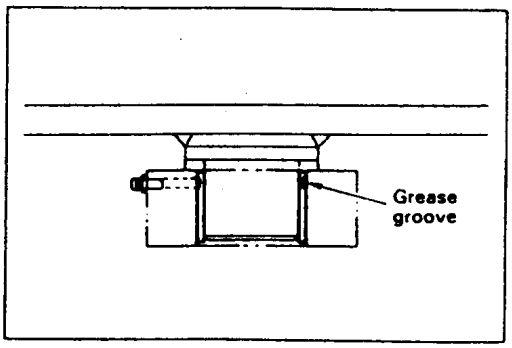
3. Install the spacer at the rear side center pin.
   The first spacer shall be installed with its chamfering at the inside diameter in contact with the center pin boss.



[Point 2]

Inspection: Measure the inside diameter of the rear axle center pin bushing.

Limit inside diameter: 52.0 mm (2.047 in)

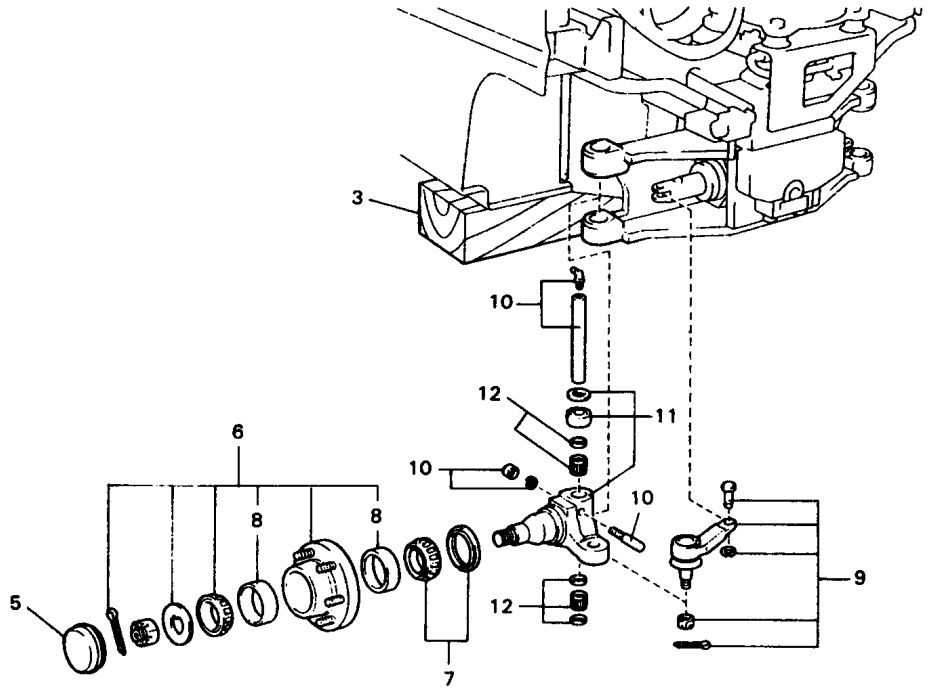


Installation: Coat MP grease on the bushing before installation.

Installation: Install the bushing with its grease groove facing the grease fitting hole in the bracket cap.

REAR AXLE HUB·STEERING KNUCKLE

REMOVAL·INSTALLATION



1 Front wheel
2 Hub nuts
4 Rear wheel

Removal Procedure

1 Chock the front wheels.

2 Loosen the rear wheel hub nuts.

3 Jack up the frame and support it with a stand or wooden blocks.

4 Remove the rear wheel. **[Point 1]**

5 Remove the hub cap. **[Point 2]**

6 Remove the rear axle hub W/bearing. **[Point 3]**

7 Remove the bearing and oil seal from the steering knuckle. **[Point 4]**

8 Remove the bearing outer races from the hub. **[Point 5]**

9 Remove the tie rod ASSY. **[Point 6]**

10 Remove the king pin lock pin, and remove the king pin. **[Point 7]**

11 Remove the steering knuckle and thrust bearing. **[Point 8]**

12 Remove the oil seal and bearing from the rear axle beam. **[Point 9]**

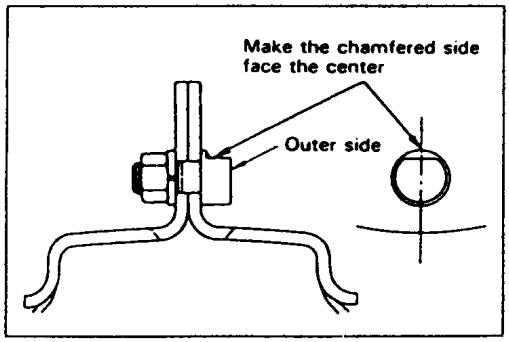
Installation Procedure

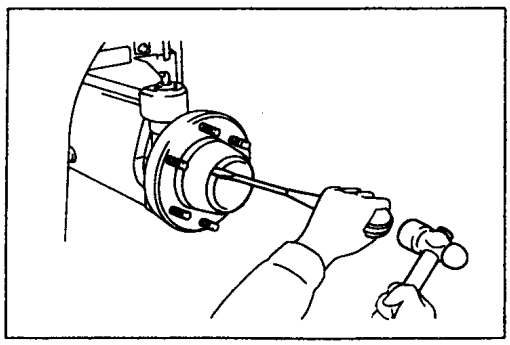
The installation procedure is the reverse of the removal procedure.

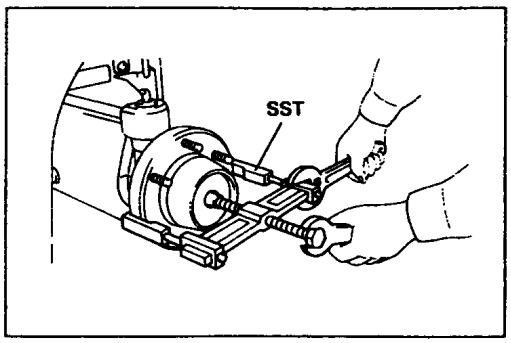
Note:
- **Supply MP grease through the king pin grease fitting.**
- **The tightening torque for each portion is as follows:**

Unit: N·m (kgf-cm) [ft-lbf]

King pin lock pin lock nut	18.63 ~ 30.41 (190 ~ 310) [13.75 ~ 22.43]
Divided rim bolt set nut	FBMF16: 29.42 ~ 44.13 (300 ~ 450) [21.71 ~ 32.56] FBMF20·25·30: 49.03 ~ 68.85 (500 ~ 700) [36.18 ~ 50.65]
Hub nut	FBMF16: 88.26 ~ 156.9 (900 ~ 1600) [65.12 ~ 115.76] FBMF20·25·30: 117.68 ~ 196.13 (1200 ~ 2000) [86.82 ~ 144.70]







Point Operations

[Point 1]

Installation: In the case of a divided rim type wheel, install with the divided rim set bolt head on the outer side of the vehicle.

Disassembly: When a wheel is removed for disassembly, always discharge air fully before disassembling the wheel.

Reassembly: The divided rim set bolt shall be installed with its head chamfered side facing the center of the wheel.

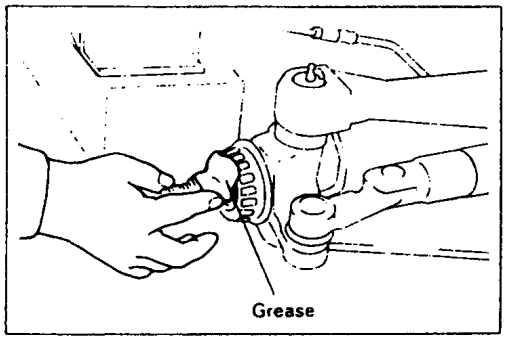
[Point 2]

Installation: Fill MP grease in the cap.

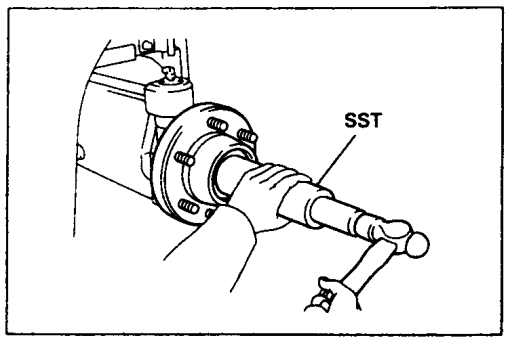
Installation: Install by tapping the cap flange portion.

[Point 3]

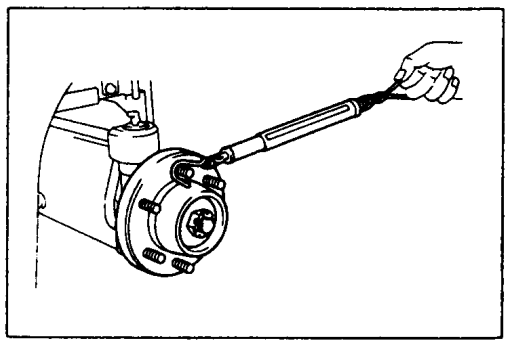
Removal: SST 09950-76014-71 (SST 09950-40011)



Installation: Fill grease in the hub and knuckle spindle



Installation: SST 09370-20270-71



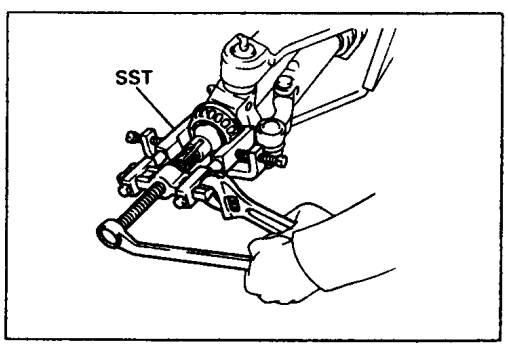
Installation: Adjust the rear axle hub starting force.

1. Temporarily tighten the castle nut to a torque of 0.98 N·m (10 kgf-cm) [0.72 ft-lbf], and rotate the hub by 3 to 5 turns.

2. Set a spring scale on the hub bolt, and measure the starting force.

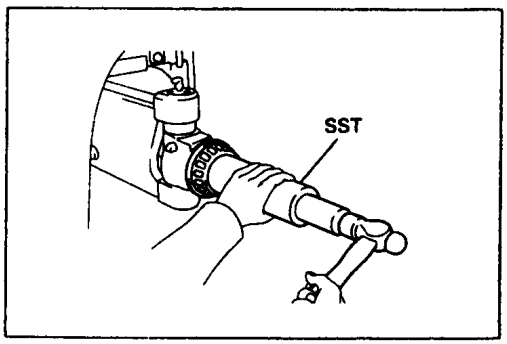
   Starting force:
   FBMF16
   14.7 ~ 39.2 N (1.5 ~ 4.0 kgf) [3.3 ~ 8.8 lbf]
   FBMF20·25·30
   14.7 ~ 44.1 N (1.5 ~ 4.5 kgf) [3.3 ~ 9.9 lbf]

3. **If the measured value does not satisfy the standard, make adjustment by tightening or loosening the castle nut.**

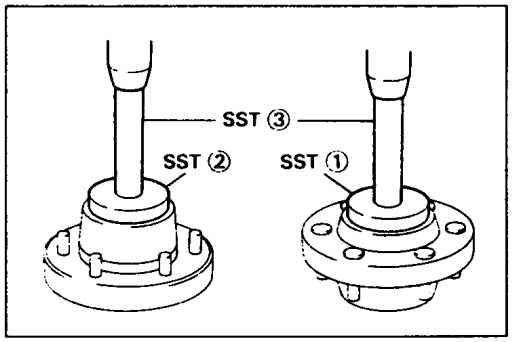


[Point 4]

Removal: SST 09950-76014-71 (SST 09950-40011)



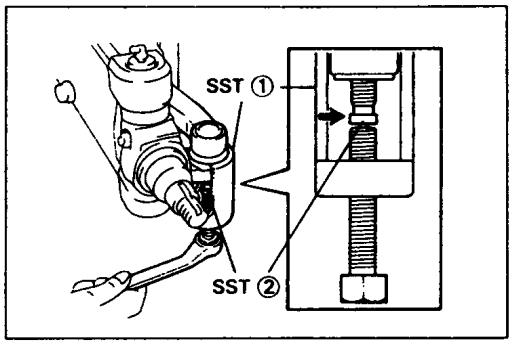
Installation: SST 09370-20270-71



[Point 5]

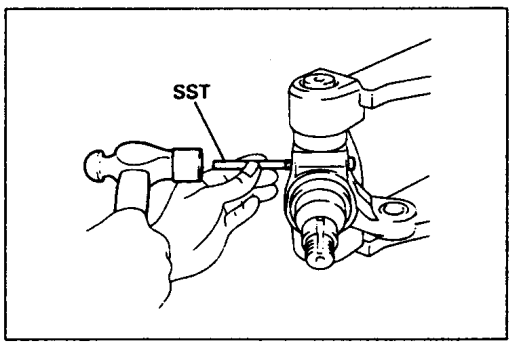
Removal: Using a brass bar, remove the outer races.

Installation: Using SST, install new outer races.
SST 09370-10170-71 .....①
SST 09950-76019-71 (SST 09950-60020)....②
SST 09950-76020-71 (SST 09950-70010)....③



[Point 6]

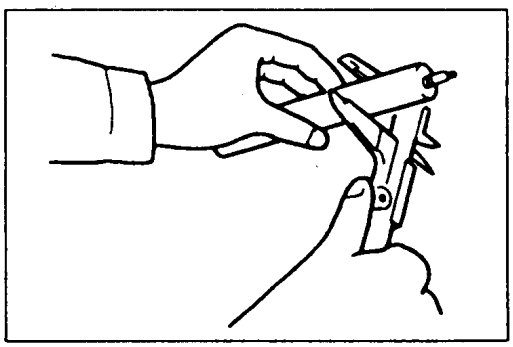
Removal: SST 09610-76002-71 (SST 09610-20012) ....①
SST 09950-76014-71 (SST 09950-40011) ....②



[Point 7]

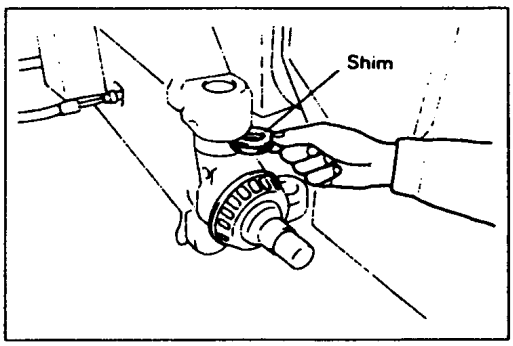
Removal: SST 09700-30200-71

Installation: Align the king pin cut groove and lock bolt hole, tighten the lock bolt, and lock by tightening the lock nut.



Inspection: Measure the king pin outside diameter.

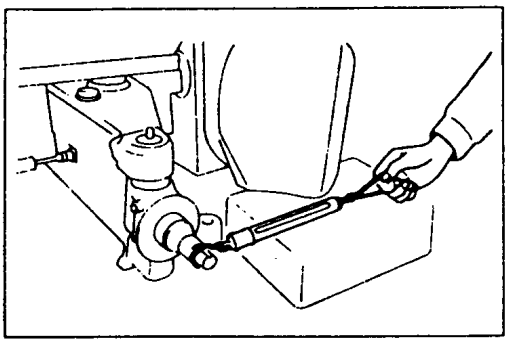
Standard outside diameter:
28.0 mm (1.102 in)
Limit outside diameter:
27.8 mm (1.094 in)



[Point 8]

Installation: Adjust the steering knuckle starting force.

1. Insert the shim on the upper side of the thrust bearing and install the king pin.

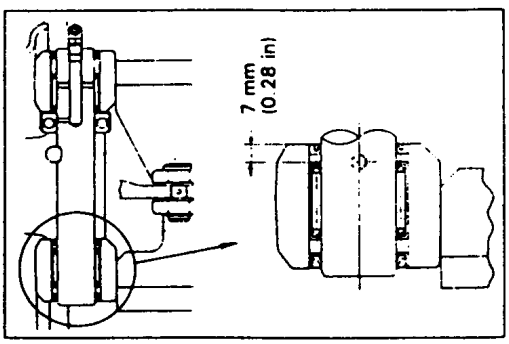


2. Set a spring scale on the tip end of the knuckle and measure the starting force.

   Starting force:
   29.4 ~ 49.0 N (3.0 ~ 5.0 kgf) [6.6 ~ 11.0 lbf]

3. If the measured value does not satisfy the standard, make adjustment by changing the shim.

   Shim thickness: **0.1·0.2·0.5 and 1.0 mm (0.22·0.44·1.1 and 2.2 in)**

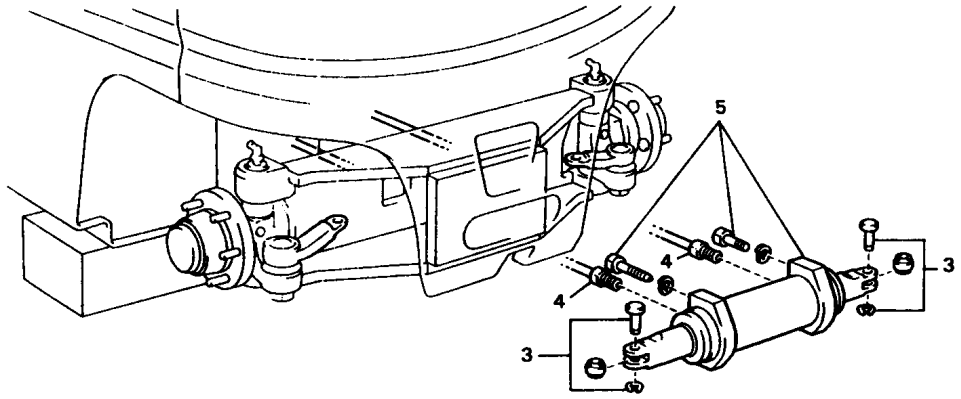


[Point 9]

Installation: Pay attention to the relative positions of the needle bearing and oil seal in the assembled state.
SST 09950-76018-71 (SST 09950-60010)
SST 09950-76020-71 (SST 09950-70010)

REAR AXLE CYLINDER

REMOVAL·INSTALLATION



1 Rear hood
2 Counterweight

Removal Procedure

1 Open the rear hood.

2 Remove the counterweight

3 Remove the piston rod end pin.

4 Disconnect the rear axle cylinder hose.

5 Remove the rear axle cylinder ASSY.

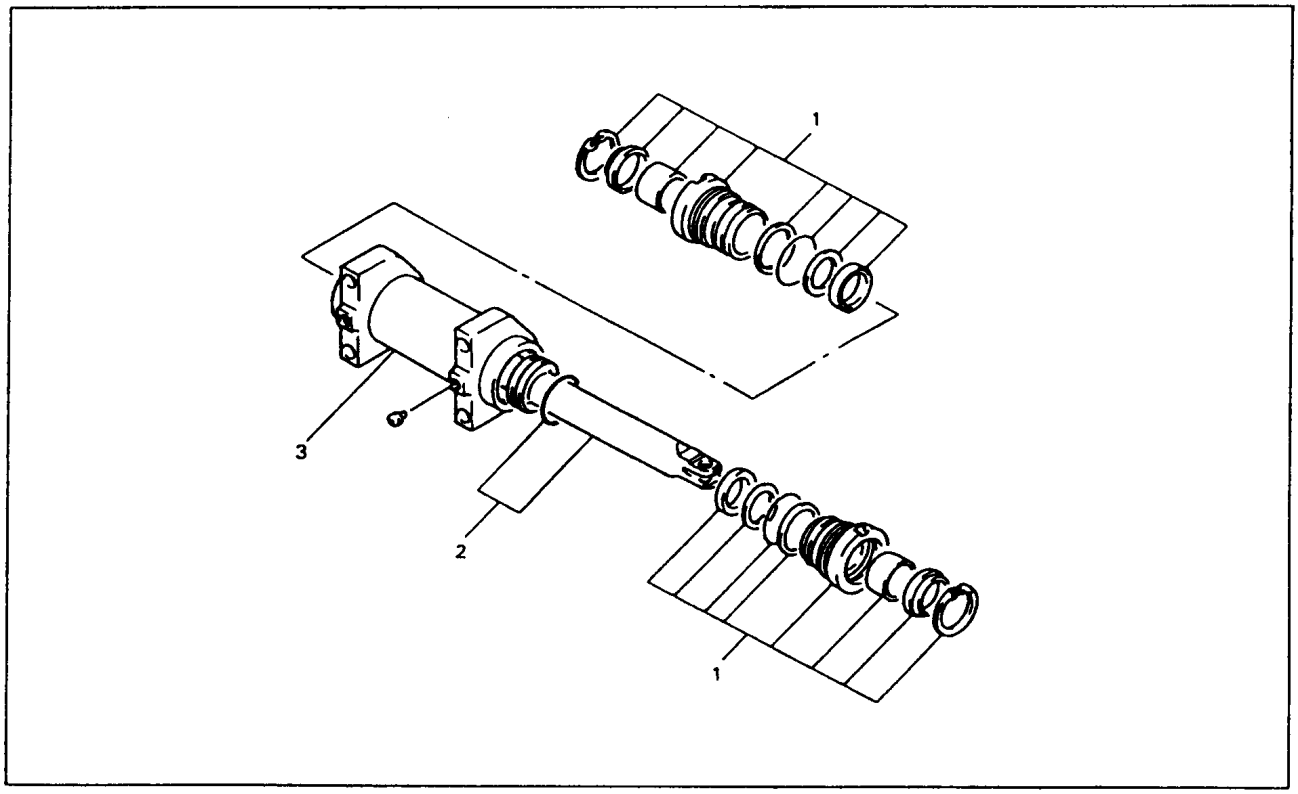
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
- **Supply MP grease through the piston rod end pin grease fitting.**
- **The tightening torque for each portion is as follows:**

Cylinder ASSY set bolt: 147 ~ 196 N·m (1500 ~ 2000 kgf-cm) [108.50 ~ 144.66 ft-lbf]

DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

1 Remove the rod guide. **[Point 1]**

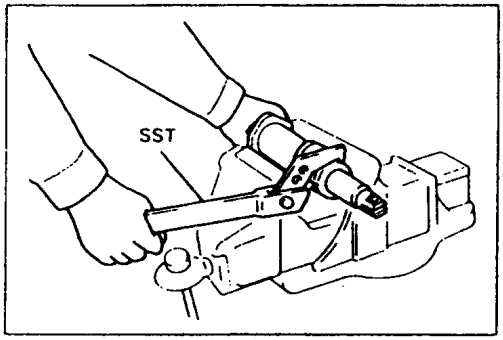
2 Extract the piston rod. **[Point 2]**

3 Remove the cylinder. **[Point 3]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

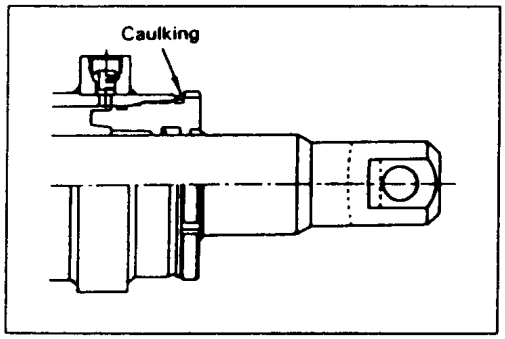
Note:
- **Coat hydraulic oil before reassembly.**
- **Coat sealant (08833-00080) on the threaded portion of the rod guide.**
- **Rod guide tightening torque T = 350 ~ 400 N·m (3570 ~ 4080 kgf-cm) [258.29 ~ 295.19 ft-lbf]**



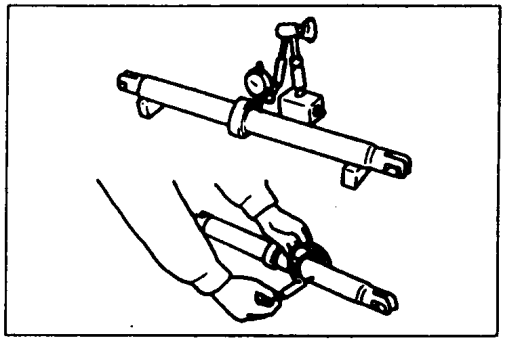
Point Operations

[Point 1]

Disassembly·reassembly: SST 09620-10100-71



Reassembly: After tightening the rod guide, caulk the cylinder end face with the rod guide groove securely.



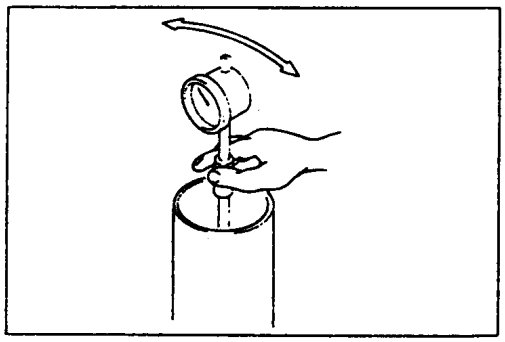
[Point 2]

Inspection: Measure the piston rod outside diameter.

Standard outside diameter:
50.00 mm (1.9685 in)
Limit outside diameter:
49.92 mm (1.9654 in)

Inspection: Measure the piston rod bend.

Limit bend: 0.5 mm (0.020 in)



[Point 3]

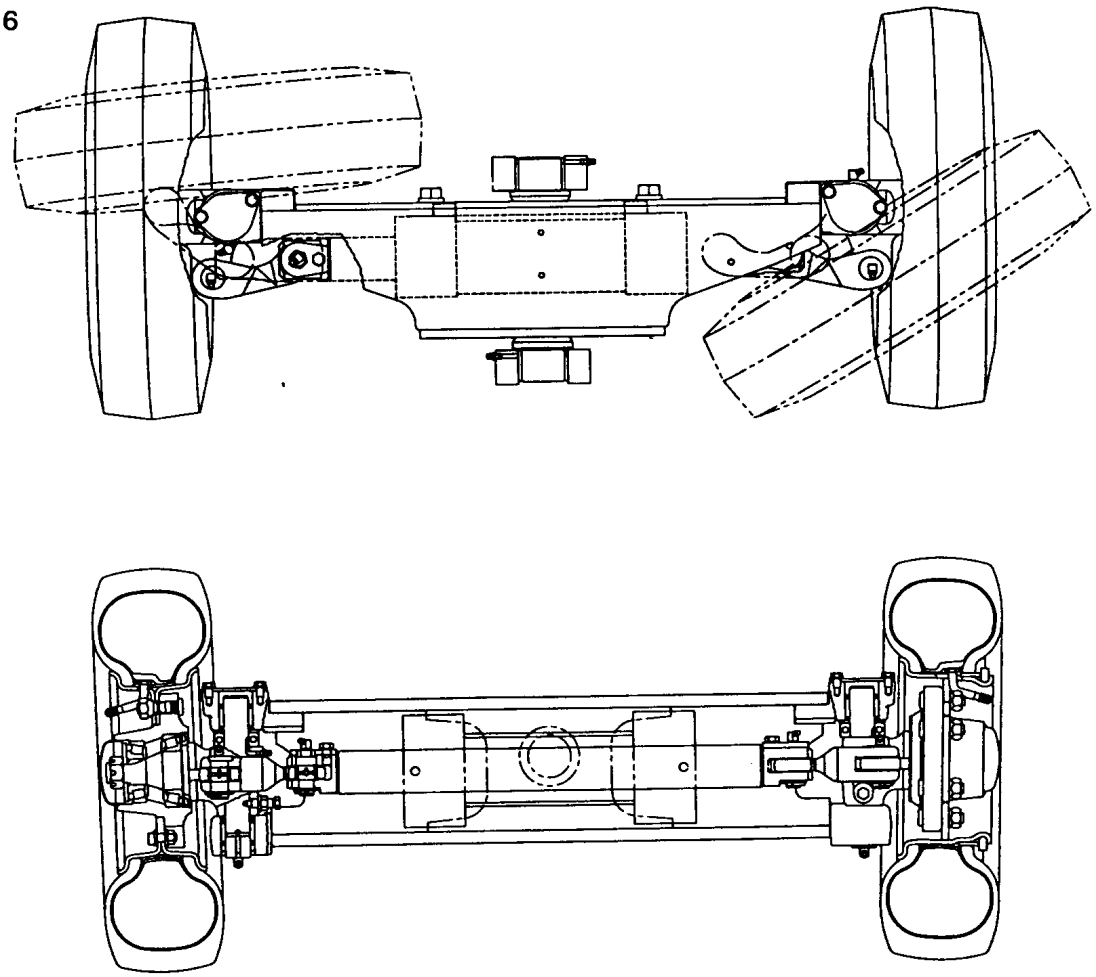
Inspection: Measure the cylinder bore.

Standard bore: 75.00 mm (2.9528 in)
Limit bore: 75.35 mm (2.9665 in)

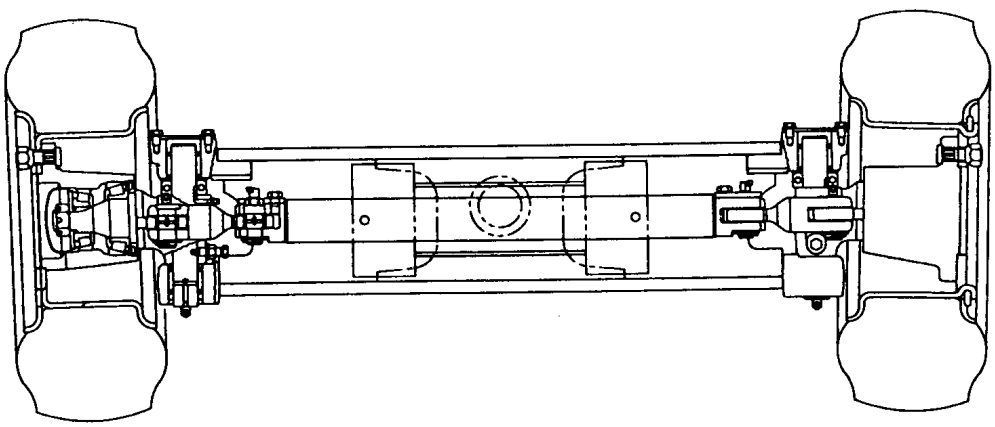
REAR AXLE
(From June 1999)

GENERAL

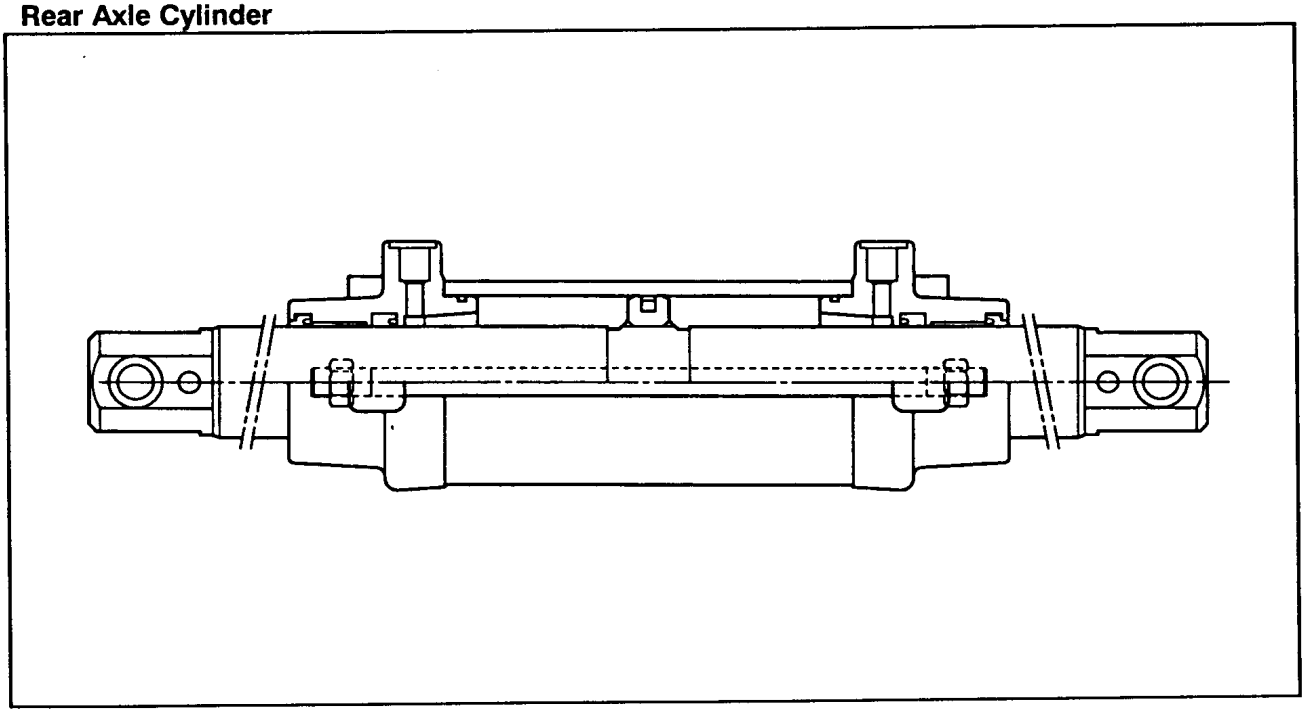
FBMF16



FBMF20•25•30

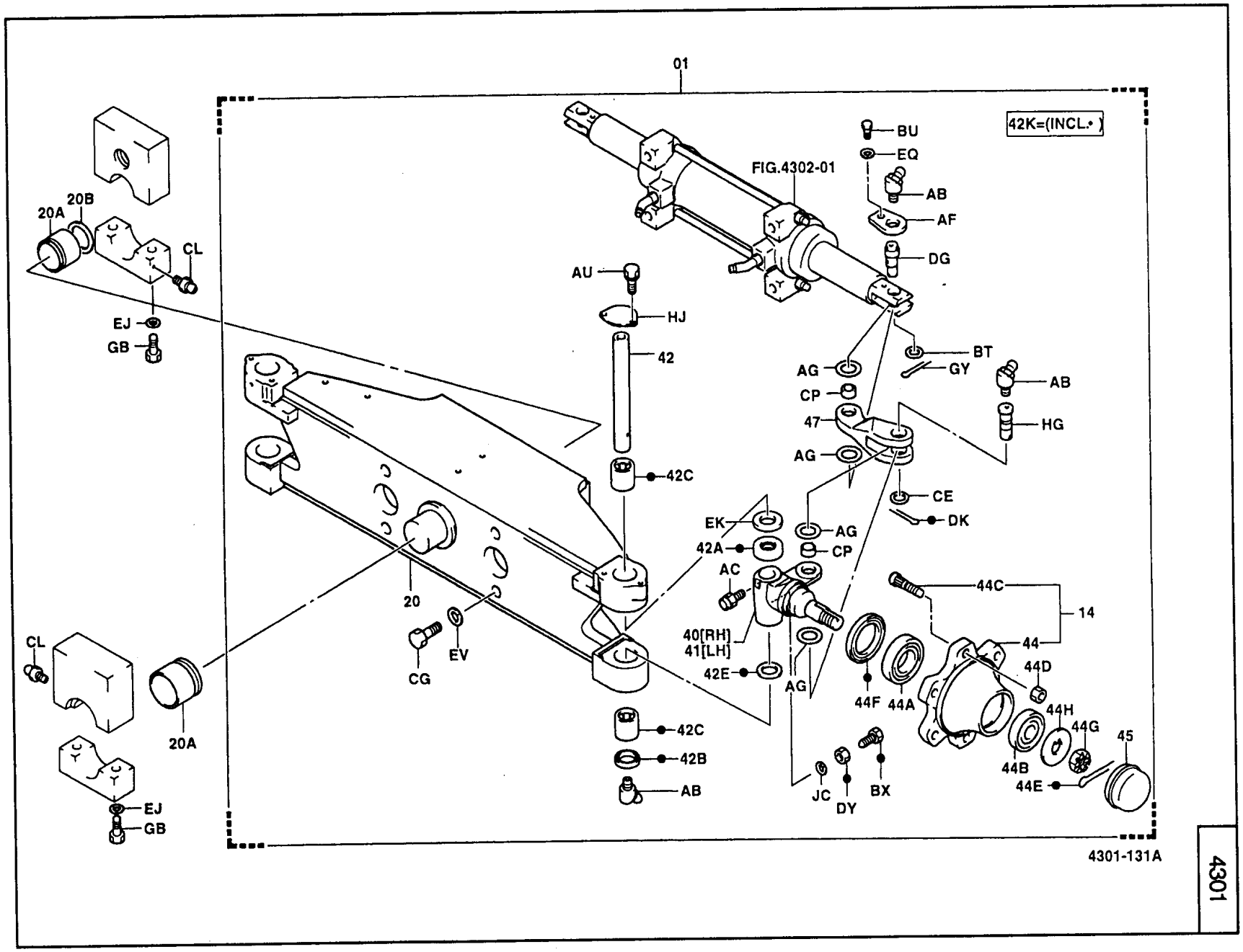


Rear Axle Cylinder

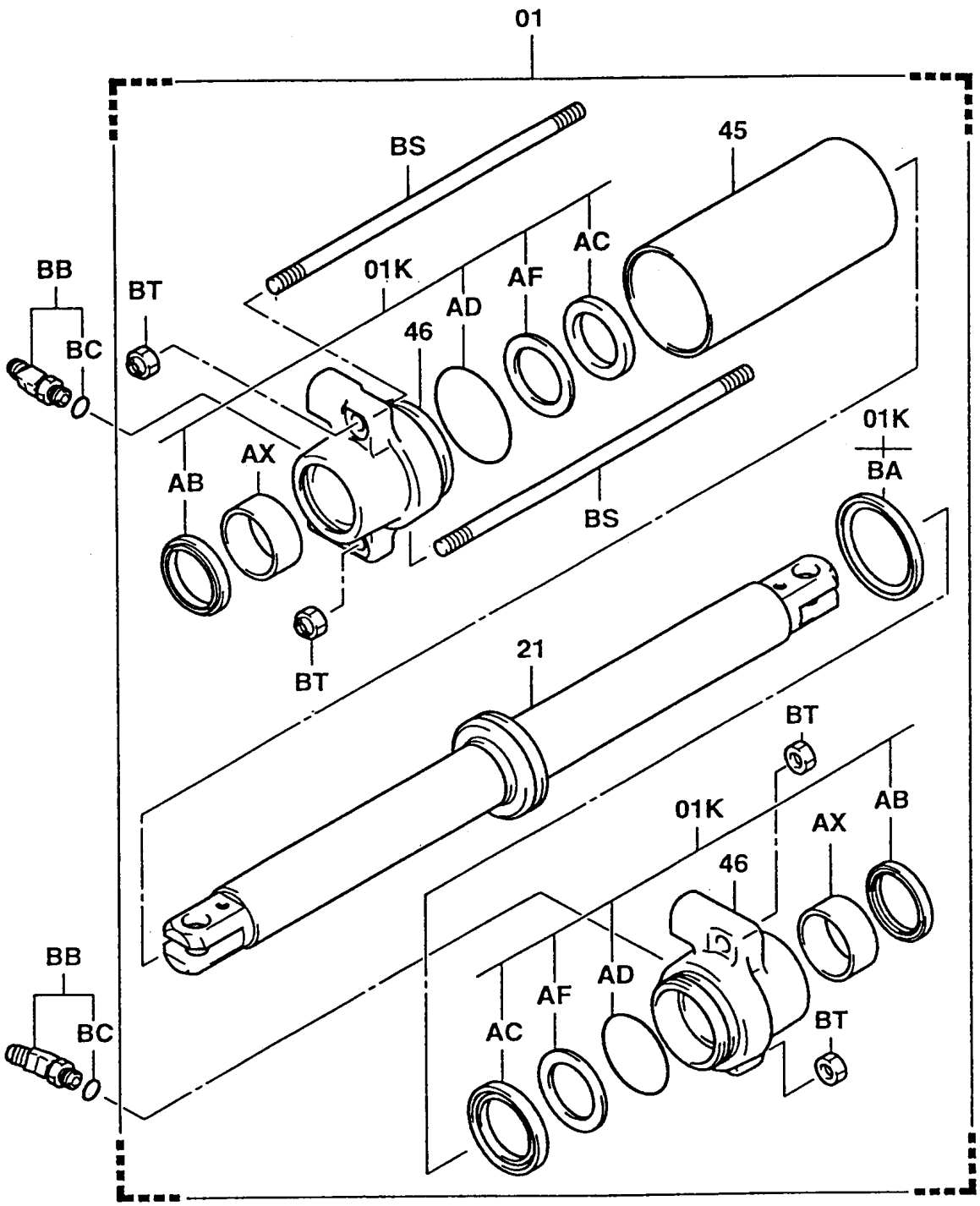


SPECIFICATIONS

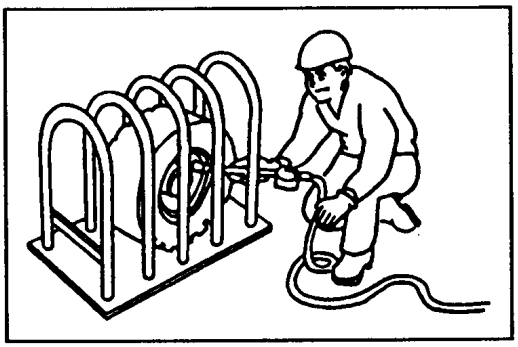
Rear axle type			Elliot type
Rear axle suspension type			Center-supported right-left rocking type
Wheel alignment	Toe-in	mm (in)	0 (0)
	Camber	degree	1.5°
	Caster	degree	0°
	King pin angle		0°
Minimum turning radius (outermost)		mm (in)	FBMF16 : 1800 (70.9)
			FBMF20 : 1960 (77.2)
			FBMF25 : 1980 (78.0)
			FBMF30 : 2130 (83.9)



4302



4302-024



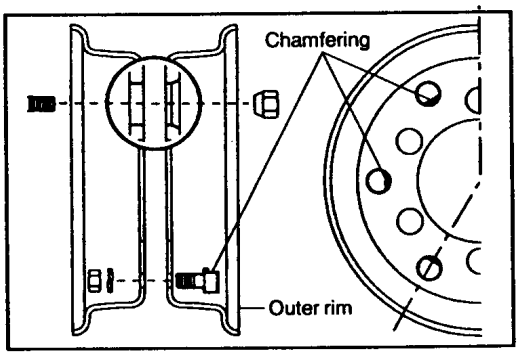
TIRES·WHEELS

1. Adjusting the Inflating Pressure

Caution:
- **Do not inflate tires beyond the specified pressure because it may cause dangerous tire bursting.**
- **When inflating a tire removed from the vehicle, place it in a safety fence.**

Specified Inflating Pressure

Model	Rim type	Rim size	Pneumatic shaped cushion tire	Pneumatic tire	Inflating pressure kPa (kgf/cm²) [psi]
FBMF16	Divided	8 x 3.00D DT	5.00-8	5.00-8-8PR	800 (8.0) [114]
	Side ring	8 x 3.00D TB	↑	↑	↑
FBMF20·25	Divided	8 x 4.25 DT	18 x 7-8	18 x 7-8-16PR	700 (7.0) [100]
	Side ring	8 x 4.33R TB	↑	↑	900 (9.0) [128]
FBMF30	Side ring	↑	↑	↑	↑



2. Wheel Disassemly·Reassembly

Caution:
Always discharge air fully before disassembling the wheel. Otherwise, it is very dangerous since the rim may come off suddenly due to the internal pressure.

Note:
Install each divided rim set bolt with its head on the outer rim side and the chamfered portion facing the center of the wheel.

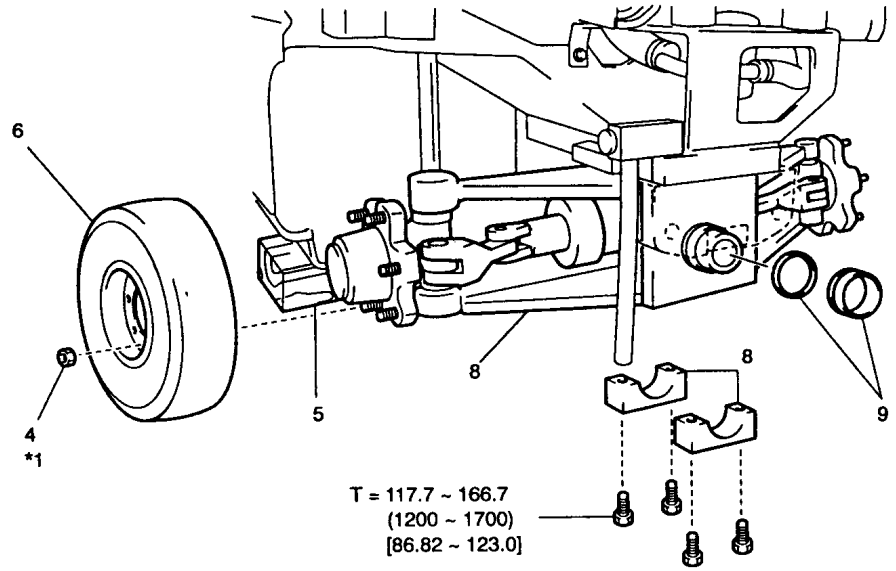
T = N·m (kgf-cm) [ft-lbf]

FBMF16	T = 29.4 ~ 44.1 (300 ~ 450) [21.7 ~ 32.6]
FBMF20·25·30	T = 49.0 ~ 68.6 (500 ~ 700) [36.2 ~ 50.7]

REAR AXLE ASSY

REMOVAL·INSTALLATION

T = N·m (kgf-cm) [ft-lbf]



*1 Hub nut

	FBMF16	FBMF20·25	FBMF30
Devided rim	88.3 ~ 157.0 (900 ~ 1600) [65.12 ~ 115.8]	117.7 ~ 196.1 (1200 ~ 2000) [86.82 ~ 144.7]	–
Side ring rim	88.3 ~ 157.0 (900 ~ 1600) [65.12 ~ 115.8]	117.7 ~ 196.1 (1200 ~ 2000) [86.82 ~ 144.7]	88.3 ~ 157.0 (900 ~ 1600) [65.12 ~ 115.8]

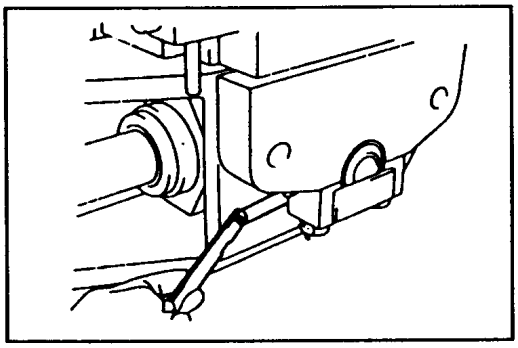
Removal Procedure

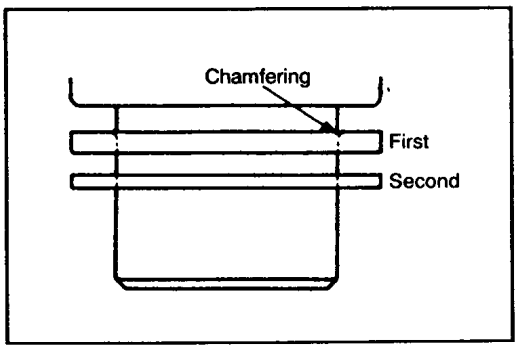
1 Open the rear hood.
2 Remove the counterweight.
3 Chock the front wheels.
4 Loosen the rear wheel hub nuts.
5 Jack up the vehicle and support it with a stand or wooden blocks.
6 Remove the rear wheels.
7 Disconnect the rear axle cylinder hoses.
8 Remove the rear axle ASSY while supporting it with a jack. **[Point 1]**
9 Remove the rear axle center pin bushing. **[Point 2]**

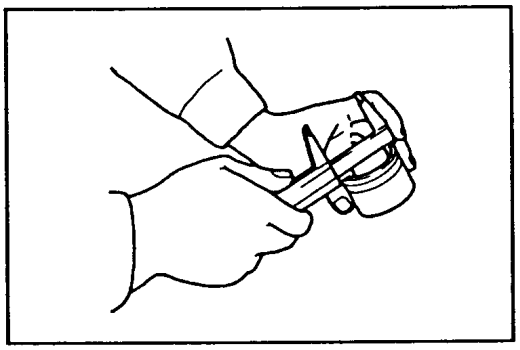
Installation Procedure

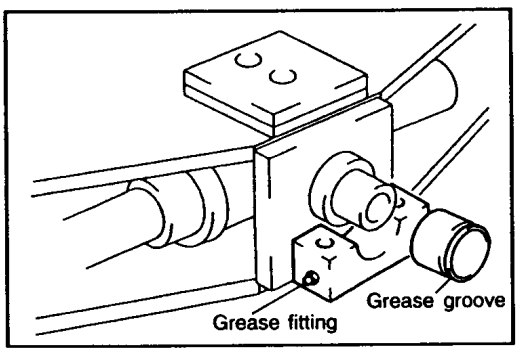
The installation procedure is the reverse of the removal procedure.

Note:
After installation, add grease through each grease fitting. Add genuine molybdenum disulfide grease at the rear axle beam center pins (two places). Use MP grease to other grease fittings.









Point Operations

[Point 1]
Inspection:
Measure the rear axle front to rear clearance.

1. Before removing the rear axle ASSY, measure the front to rear clearance on the rear side.

   Standard clearance: 0.7 mm (0.028 in) or less

2. If the measured value does not satisfy the standard, remove the rear axle ASSY and make adjustment by selecting the spacer.

   Spacer thickness:
   1.2·2.3·3.0·3.5·4.0·4.5 and 5.0 mm
   (0.047·0.091·0.118·0.138·0.157·0.177 and 0.197 in)

3. Install the spacer at the rear side center pin.
   The first spacer shall be installed with its chamfered at the inside diameter in contact with the center pin boss.

[Point 2]
Inspection:
Inspect the inside diameter of the rear axle center pin bushing.

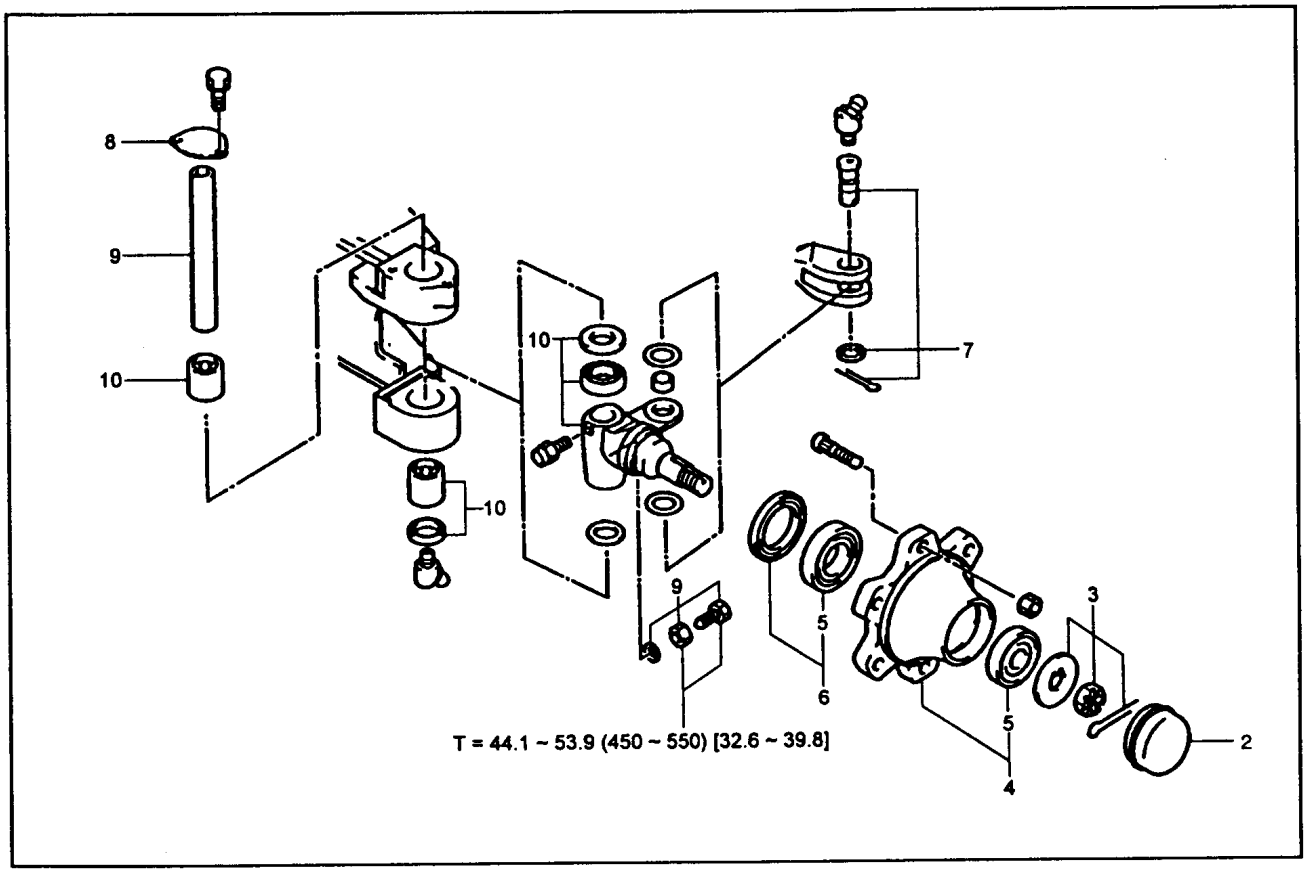
Limit: 52.0 mm (2.047 in)

Installation:
Apply molybdenum disulfide grease on the bushing and install the bushing by aligning the grease groove in the bushing with the grease fitting position.

REAR AXLE HUB·STEERING KNUCKLE

REMOVAL·INSTALLATION

T = N·m (kgf-cm) [ft-lbf]



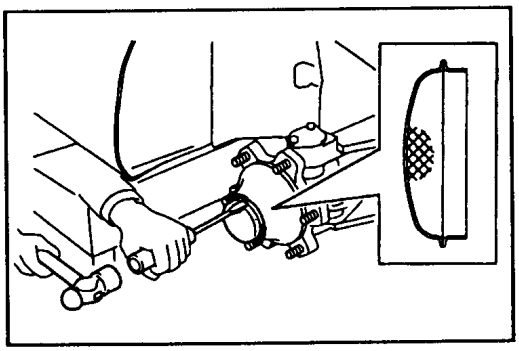
Removal Procedure

1 Jack up the vehicle and remove rear wheels.
2 Remove the hub caps. **[Point 1]**
3 Remove the castle nut and claw washer. **[Point 2]**
4 Remove the outer bearing and axle hub. **[Point 3]**
5 Remove the bearing outer race from the axle hub. **[Point 4]**
6 Remove the inner bearing roller and oil seal. **[Point 5]**
7 Disconnect the tie rod (on the knuckle side).
8 Remove the king pin cover.
9 Remove the king pin lock bolt and king pin. **[Point 6]**
10 Remove the thrust bearing, spacer and steering knuckle.
11 Remove the king pin oil seal and needle roller bearing. **[Point 7]**

Installation Procedure

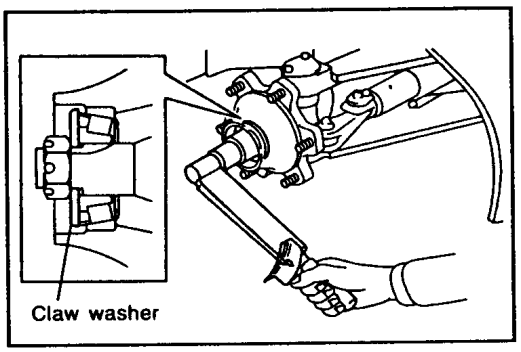
The installation procedure is the reverse of the removal procedure.

Note:
After installation, add MP grease through grease fittings.



Point Operations

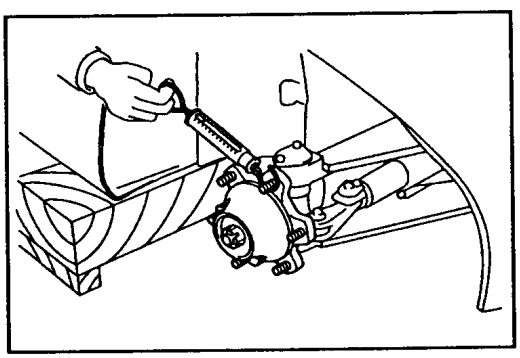
[Point 1]
Installation:
Fill MP grease in the hub cap, and install by tapping the flange portion.

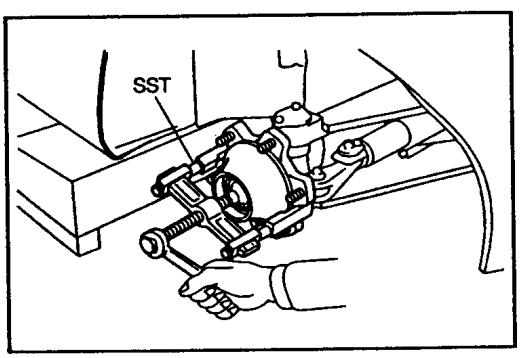


[Point 2]
Installation:
Adjust the rear axle hub starting force.
1. Install the claw washer in the correct direction.
   Outside chamfered corner should face to the outer side.
2. Install the castle nut and temporarily tighten it to a torque of 15 to 32 N·m (150 to 330 kgf-cm) [10.9 to 23.9 ft-lbf].
3. Rotate the hub by 3 to 5 turns to run in the bearing.
4. Set a spring scale on a hub bolt, and measure the starting force.

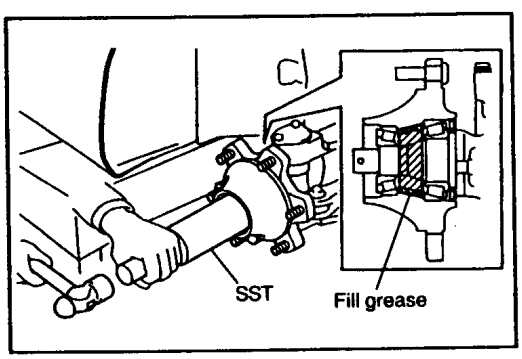
   Standards:
   FBMF16: 15 ~ 39 N (1.5 ~ 4.0 kgf) [3.3 ~ 8.8 lbf]
   FBMF20·25·30: 15 ~ 44 N (1.5 ~ 4.5 kgf) [3.3 ~ 9.9 lbf]

5. If the standard is not satisfied, adjust the degree of castle nut tightening for adjustment.
6. Install a new cotter pin.

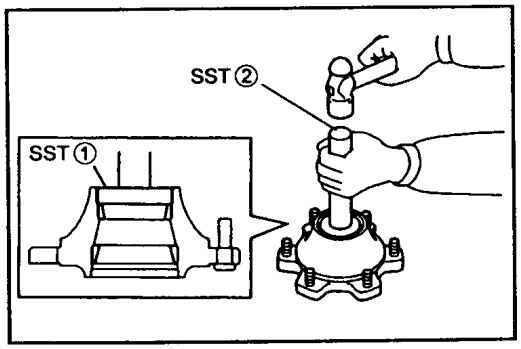




[Point 3]
Removal:
SST 09950-40011

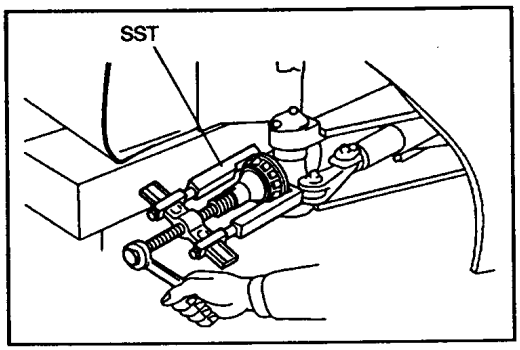


Installation:
Install the axle hub and outer bearing.
1. Fill MP grease in the axle hub and knuckle spindle.
2. Install the axle hub.
3. Use the SST and install the outer bearing roller.
   SST 09370-20270-71

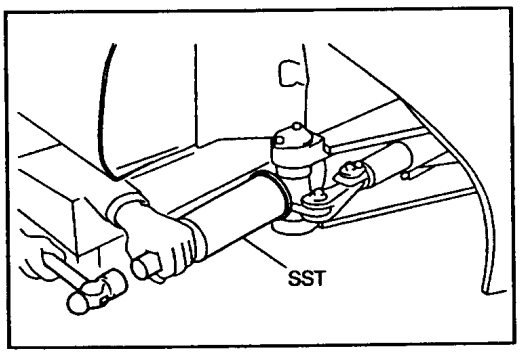


[Point 4]
Removal:
Use a brass bar and remove the bearing outer race.

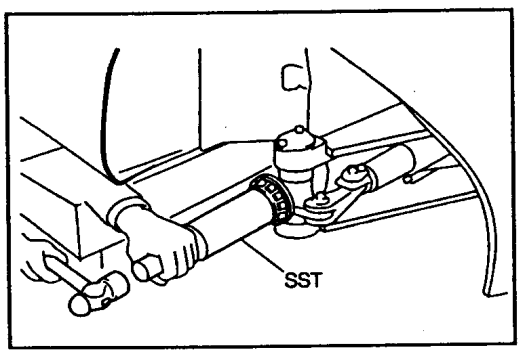
Installation:
SST 09950-60020 --- ①
09950-70010 --- ②



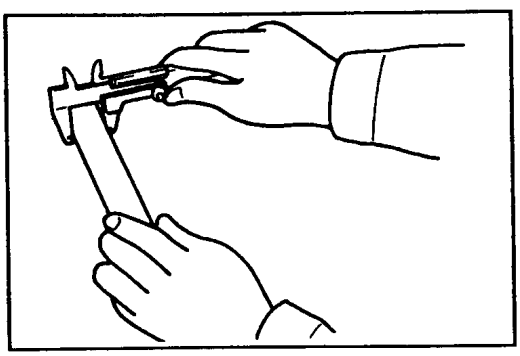
[Point 5]
Removal:
SST 09950-40011



Installation:
Install the oil seal and inner bearing roller.
1. Use the SST and install the oil seal.
SST 09370-10410-71

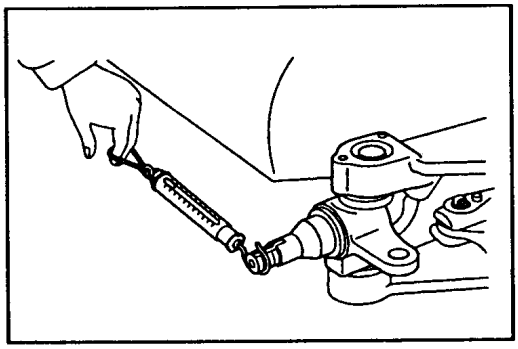


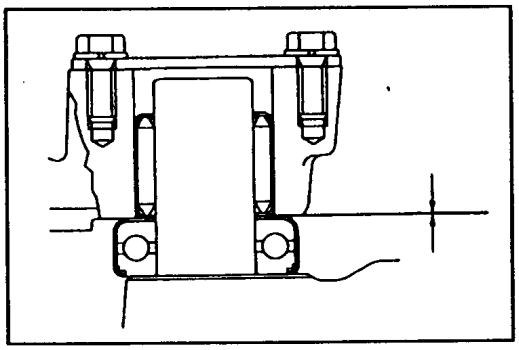
2. Use the SST and install the inner bearing roller.
SST 09370-20270-71



[Point 6]
Inspection:
Measure the king pin outside diameter.

Limit: 27.8 mm (1.094 in)





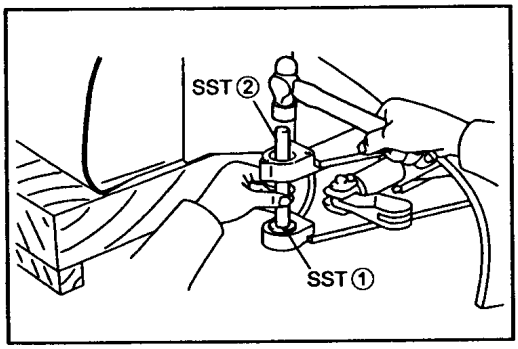
Installation:
Measure the steering knuckle starting force.
1. Temporarily install the king pin and king pin lock bolt. Select the spacer so as to minimize vertical looseness of the knuckle, and install it on top of the thrust bearing.
2. Set a spring scale at the tip end of the knuckle spring, and measure the starting force.

   Standard: 19.3 N (2.0 kgf) [4.4 lbf] or less

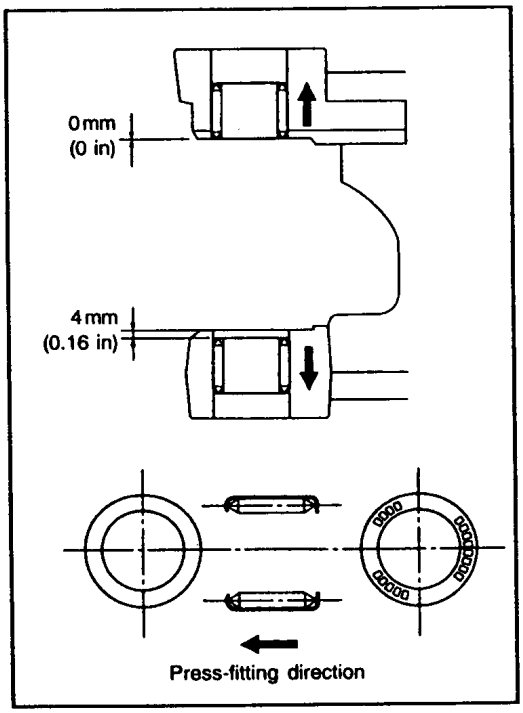
3. If the standard is exceeded, check the king pin for bend, the needle bearing for damage and axle beam for deformation.

   Spacer thickness: 3.0, 3.5, 4.0 and 4.5 mm (0.118, 0.138, 0.157 and 0.177 in)

4. Tighten the lock nut for the king pin lock bolt.



[Point 7]
Removal:
Remove the king pin oil seal and needle roller bearing.
1. Use a straight-edge screwdriver to remove the dust seal and oil seal.
2. Use the SST and remove the needle roller bearing.
   SST 09950-60010 --- ①
   09950-70010 --- ②

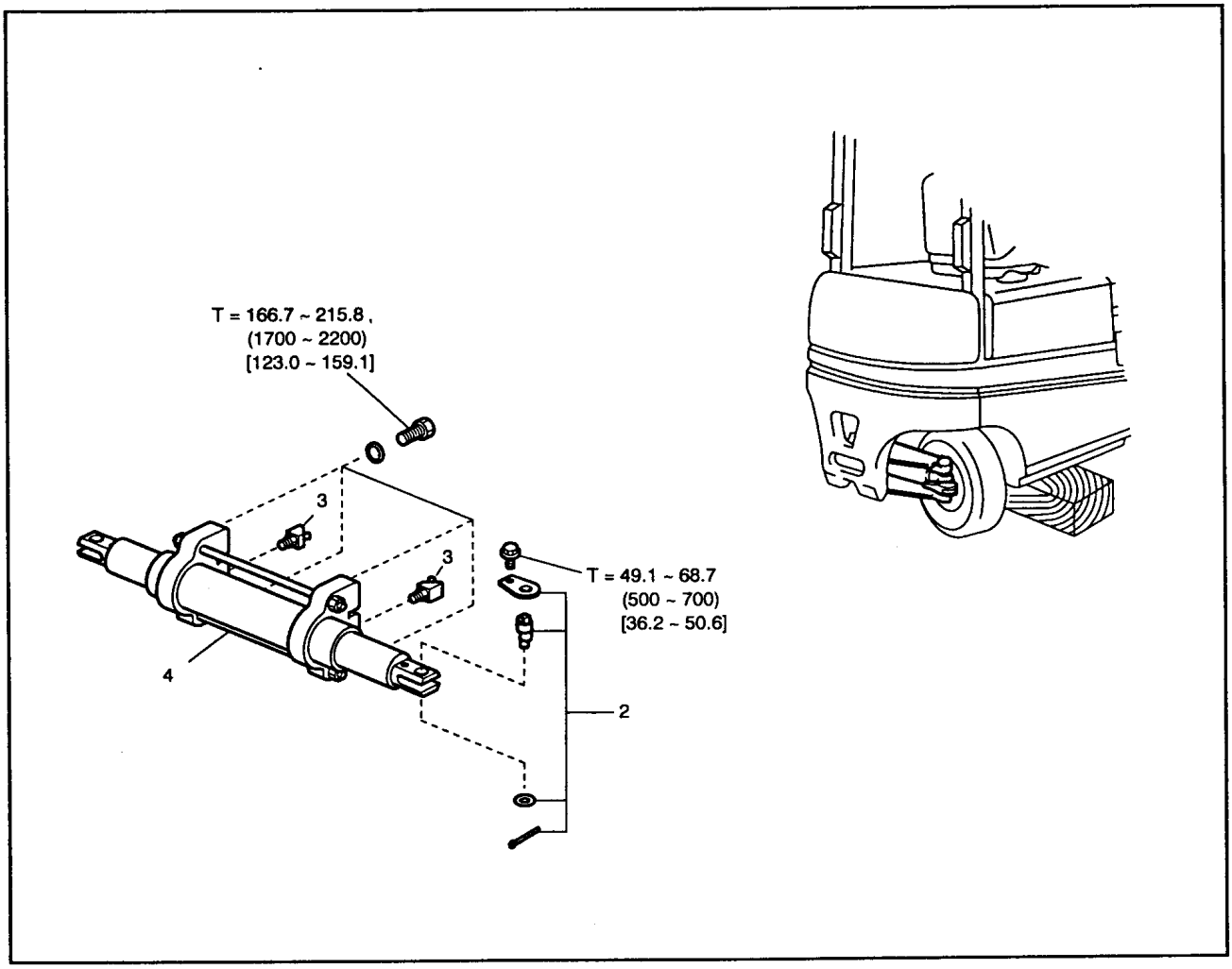


Installation:
Install the needle roller bearing and king pin oil seal.
1. Use the SST and install the needle bearing.
   Check the needle roller bearing press-fitting surface, pressing direction and installation depth.
   SST 09950-60010 --- ①
   09950-70010 --- ②
2. Install the dust seal.
3. Use the SST and install the oil seal.
   SST 09950-60010 --- ①
   09950-70010 --- ②

REAR AXLE CYLINDER

REMOVAL·INSTALLATION

T = N·m (kgf-cm) [ft-lbf]



Removal Procedure

1 Jack up the vehicle.

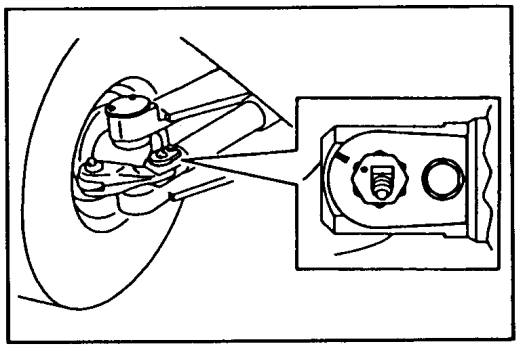
2 Disconnect the tie rod (on the piston rod side). **[Point 1]**

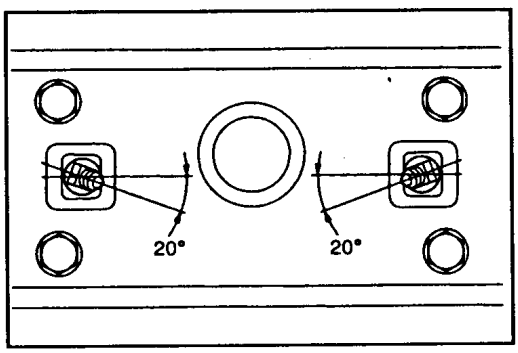
3 Disconnect the rear axle cylinder hose and remove the fitting. **[Point 2]**

4 Remove the rear axle cylinder.

Installation Procedure

The installation procedure is the reverse of the removal procedure.





Point Operations

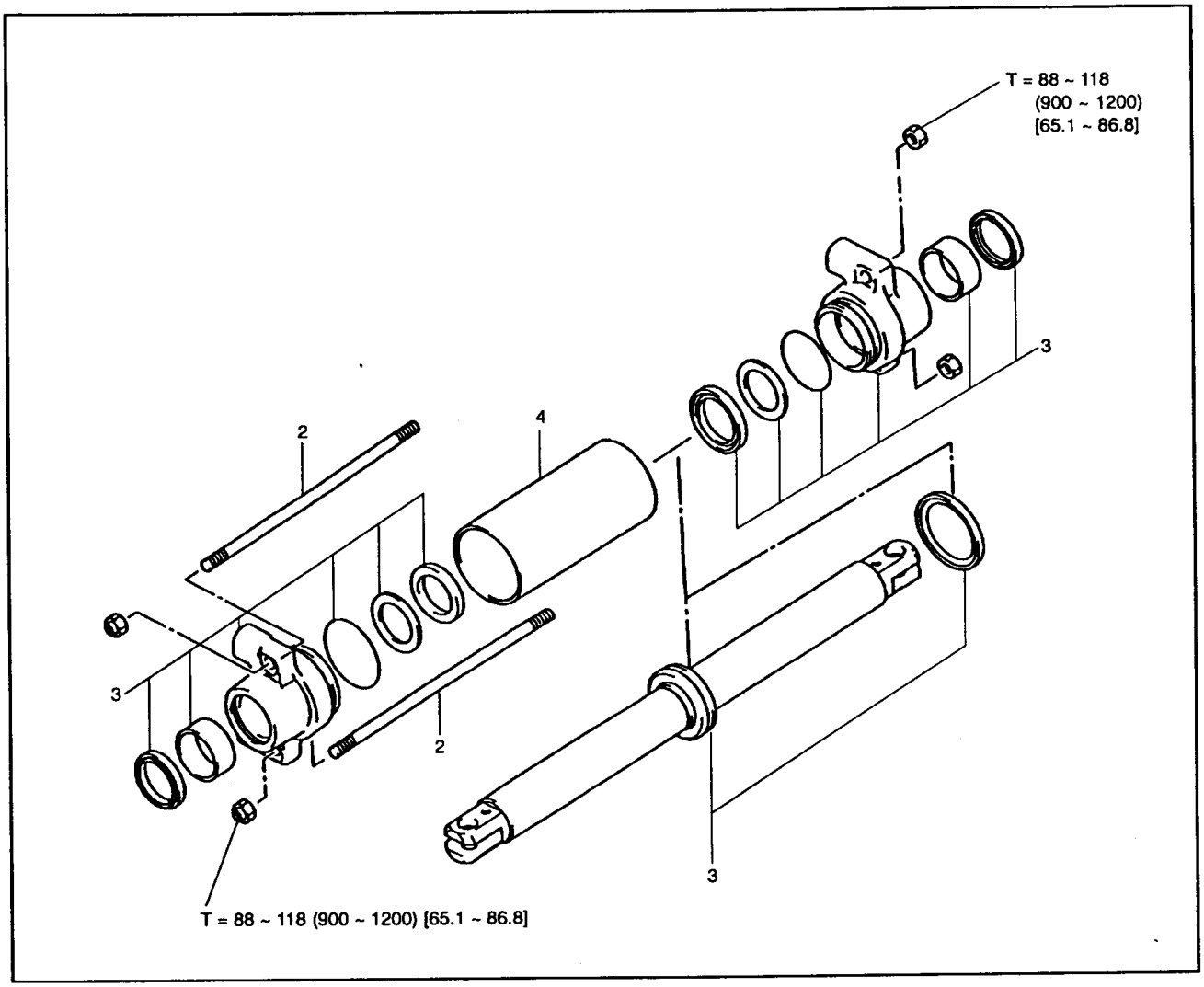
[Point 1]
Removal:
Mark the punch mark position on each of cylinder end pins LH and RH.

Installation:
Install each cylinder end pin by aligning the punch mark with the mark.

[Point 2]
Installation:
Install the fitting in the illustrated direction.

DISASSEMBLY·INSPECTION·REASSEMBLY

T = N·m (kgf-cm) [ft-lbf]



Disassembly Procedure

1 Remove the through bolt.

2 Remove the piston rod guide.

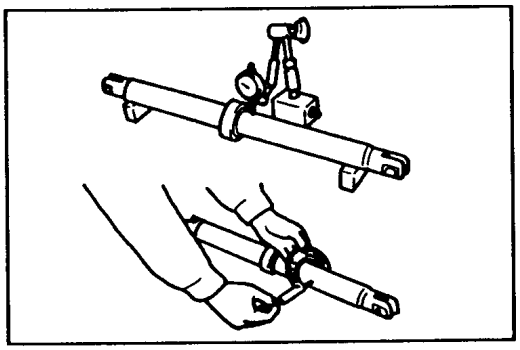
3 Remove the piston rod. **[Point 1]**

4 Inspect the cylinder. **[Point 2]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

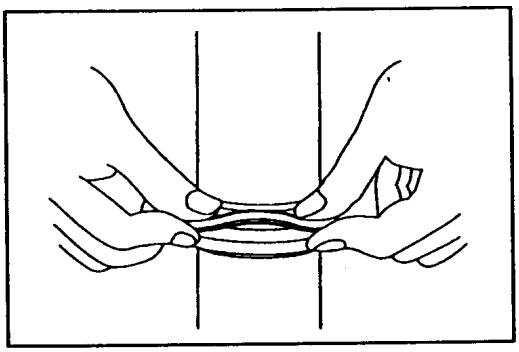
Note:
Coat hydraulic oil before reassembly.



Point Operations

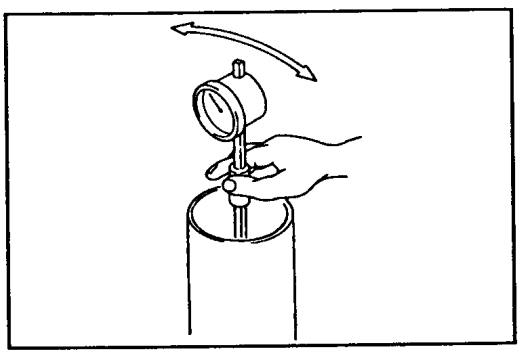
[Point 1]
Inspection:
Measure the piston rod outside diameter.
Limit: 49.92 mm (1.9654 in)

Inspection:
Measure the bend of the piston rod.
Limit: 0.5 mm (0.020 in)



Reassembly:
Warm the seal ring to a little below 80°C (176°F) in hot oil or water before installation.
Do not stretch it excessively.

Caution:
Operate carefully to avoid scalding.



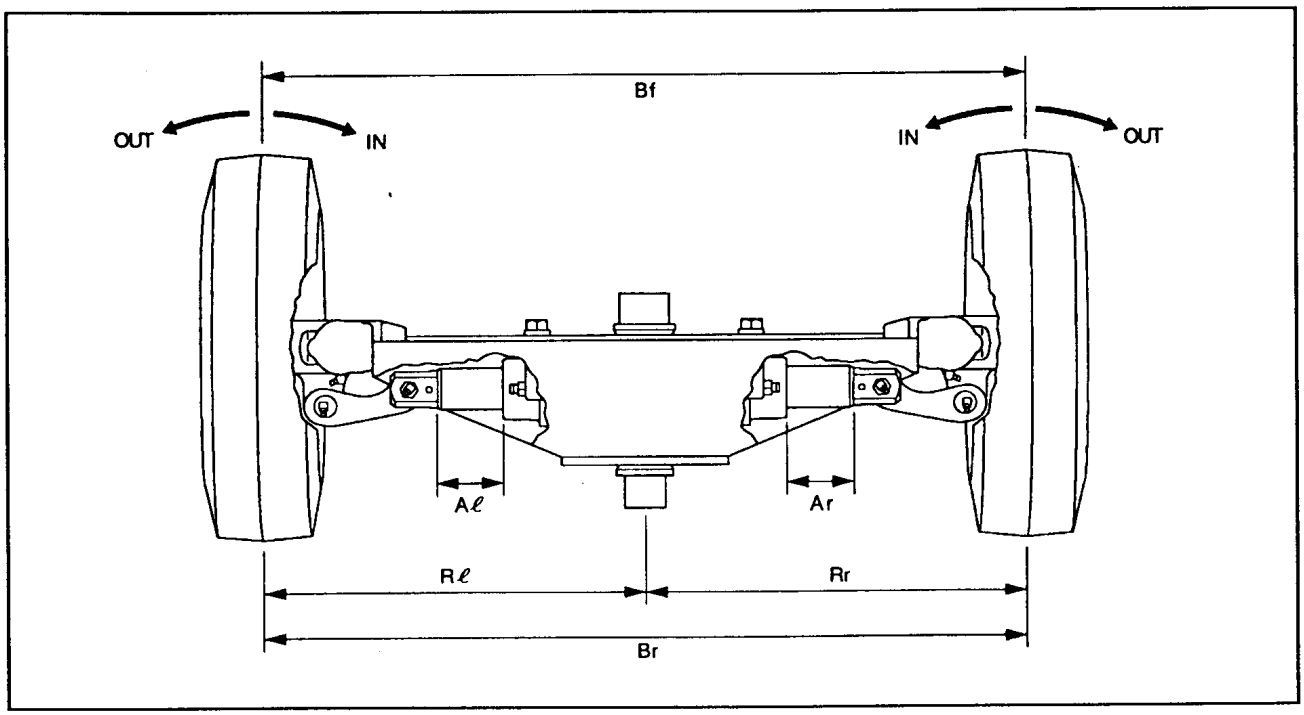
[Point 2]
Inspection:
Measure the rear axle cylinder bore.

Limit: 76.35 mm (3.0059 in)

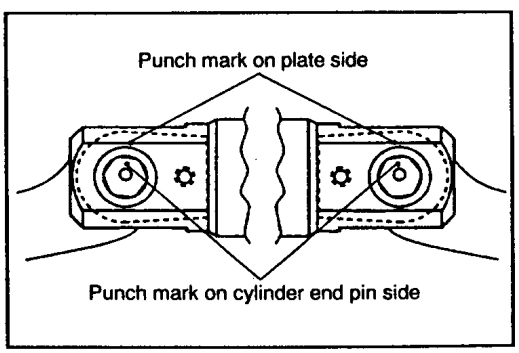
REAR WHEEL ALIGNMENT

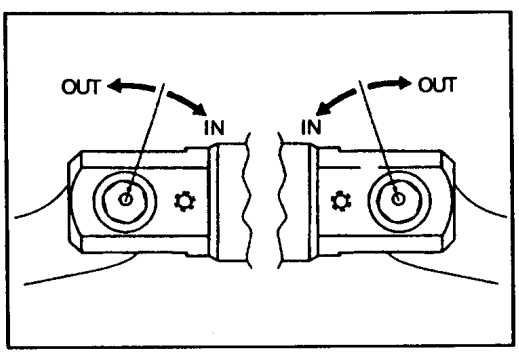
Toe-in Inspection

1. Check to see that dimensions Ar and Aℓ of the rear axle cylinder are equal.
2. Measure the toe-in (Bf - Br).
   Standard: 0 ± 4 mm (0 ± 0.16 in)



Toe-in Adjustment

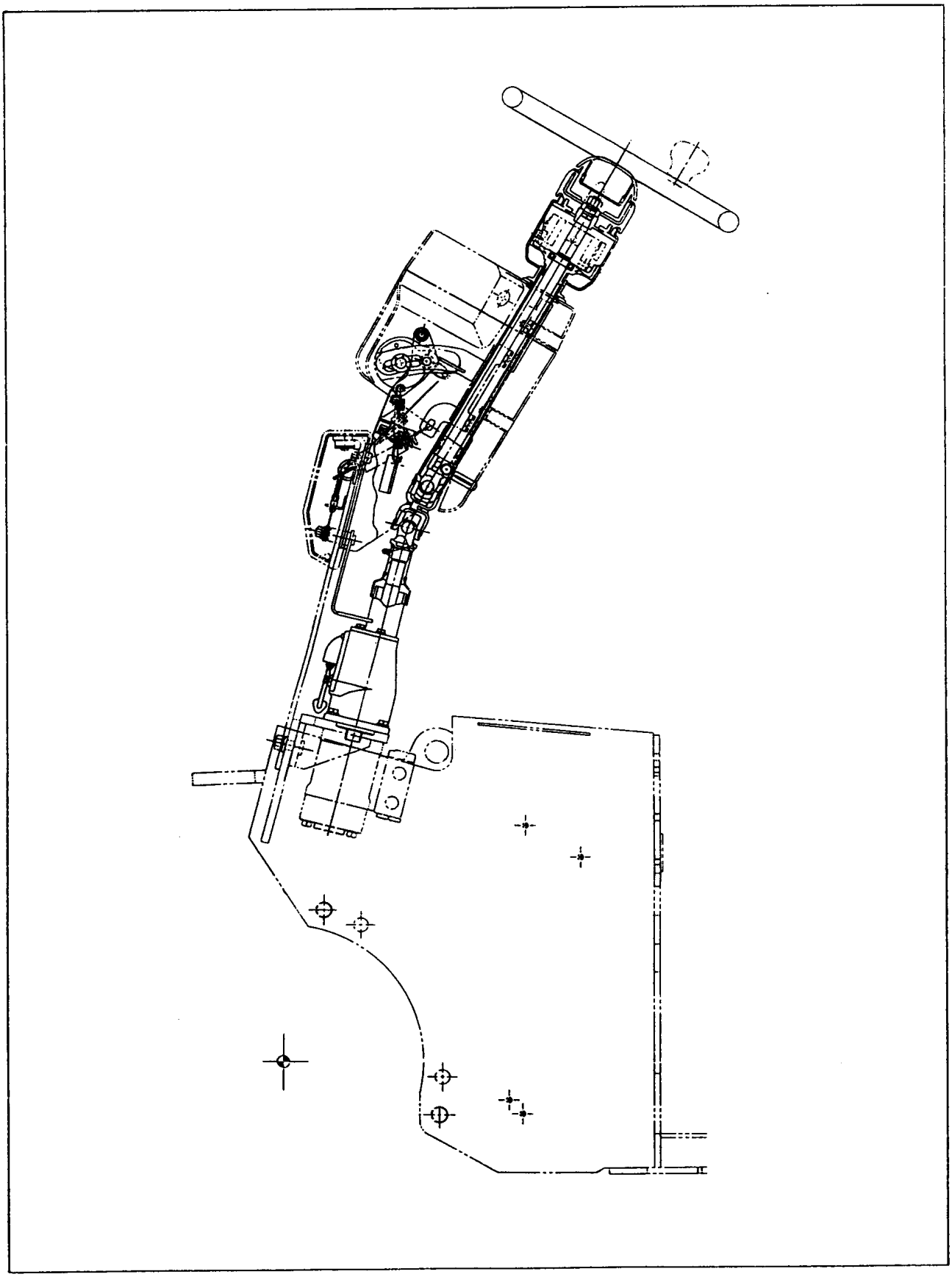




1. Check to see that Ar and Aℓ of the rear axle cylinder are equal.
2. Align the punch mark on the cylinder end pin (eccentric pin) with the punch mark on the plate on the front side for both the LH and RH sides.
3. Measure and adjust the toe-in (Bf - Br).
   Standard: 0 ± 4 mm (0 ± 0.16 in)
   If the standard is not satisfied, make adjustment by the cylinder end pin in the range where the difference between Rℓ and Rr is within 0 ± 3 mm (0.12 in).
   (1) When measued value > 4 mm (0.16 in):
   Measure Rℓ and Rr, and adjust the cylinder end pin on the smaller side toward IN.
   (2) When measured value < 4 mm (0.16 in):
   Measure Rℓ and Rr, and adjust the cylinder end pin on the greater side toward OUT.
   Note:
   - **If Rℓ equals to Rr, adjust the same amount on the LH and RH sides.**
   - **If the standard is not attained by adjustment on one side, make adjustment also on the other side.**
4. Install the plate. The plate can be installed with either face up.
5. After adjustment, fully steer the tires and check to see that they do not come into contact with the vehicle body.

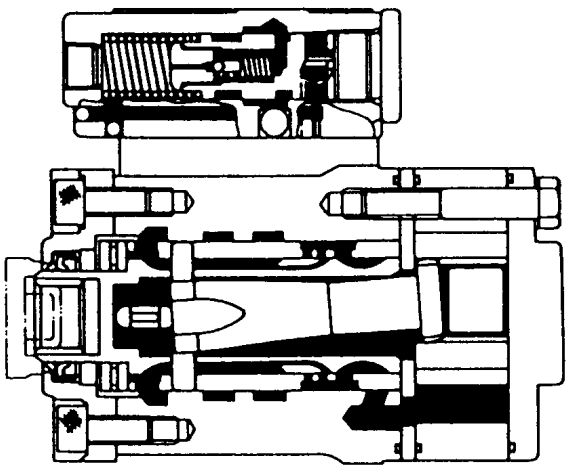
STEERING

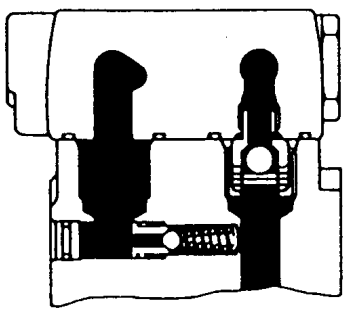
GENERAL



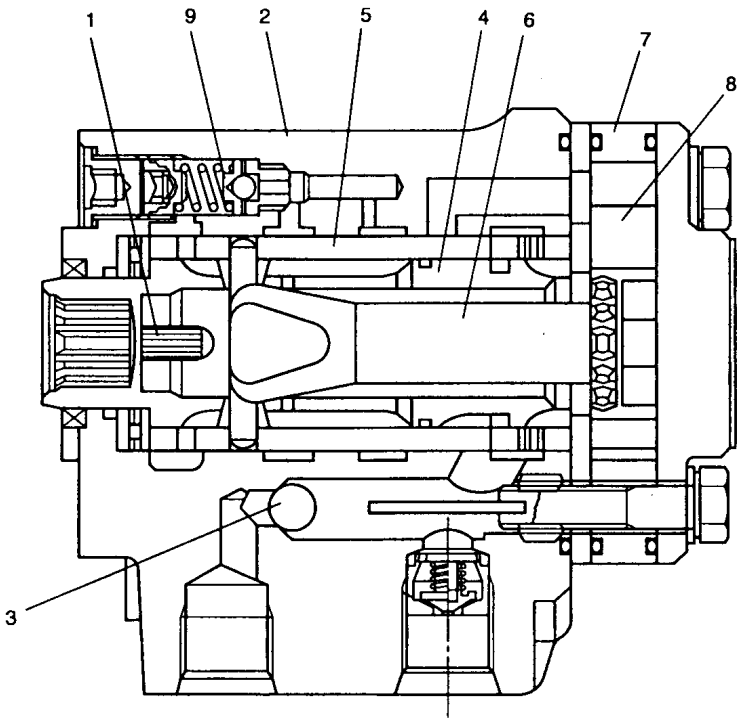
Hydrostatic Steering Valve

(Up to October 1998)





(From November 1998)



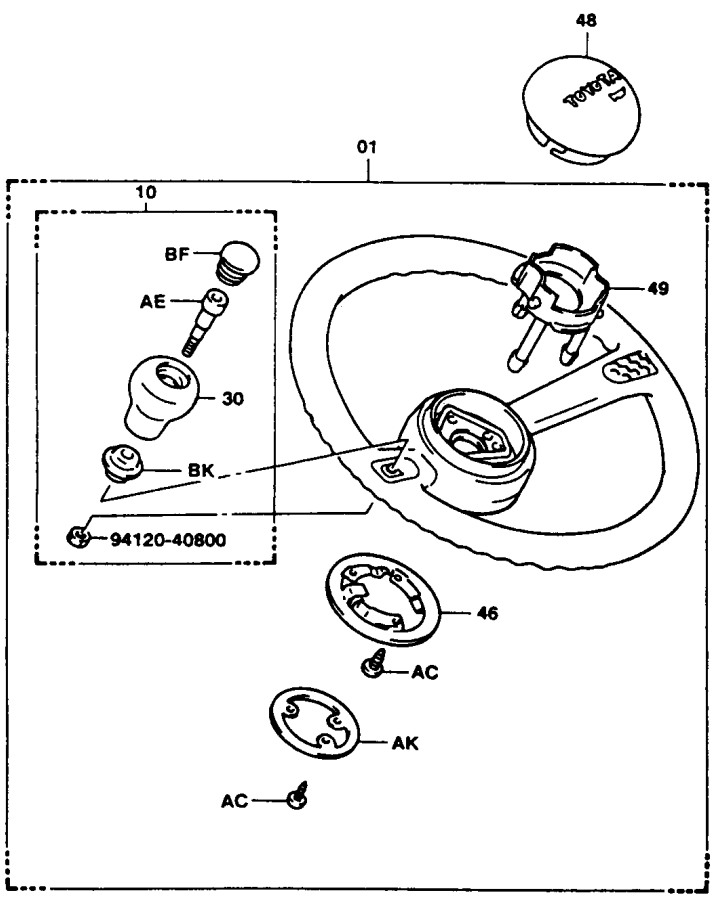
1. Neutral position spring
2. Housing
3. Check valve
4. Spool
5. Sleeve
6. Cardan shaft
7. Gear rim
8. Gear wheel (rotor)
9. Relief valve

SPECIFICATIONS

Item \ Model		FBMF16	FBMF20·25·30
Steering wheel	Diameter mm (in)	360 (14.17)	
	Play mm (in)	20 ~ 50 (1.0 ~ 2.0)	
Type		Hydrostatic power steering	
Hydrostatic steering valve	Delivery cc/rev (cu-in)	80 (4.88)	
	Maximum input torque N·m (kgf-cm)[ft-lbf]	118 (1200) [87] (Up to October 1998) 120 (1224) [88.6] (From November 1998)	
	Relief valve type	Built-in type	
	Relief valve set pressure kPa (kgf/cm²)[psi] (Up to October 1998)	5390 ~ 6370 (55 ~ 65) [780 ~ 920]	7350 ~ 8340 (75 ~ 85) [1070 ~ 1210]
	Relief valve set pressure kPa (kgf/cm²)[psi] (From November 1998)	7850 ± 49 (80 ± 5) [1140 ± 70]	

COMPONENTS

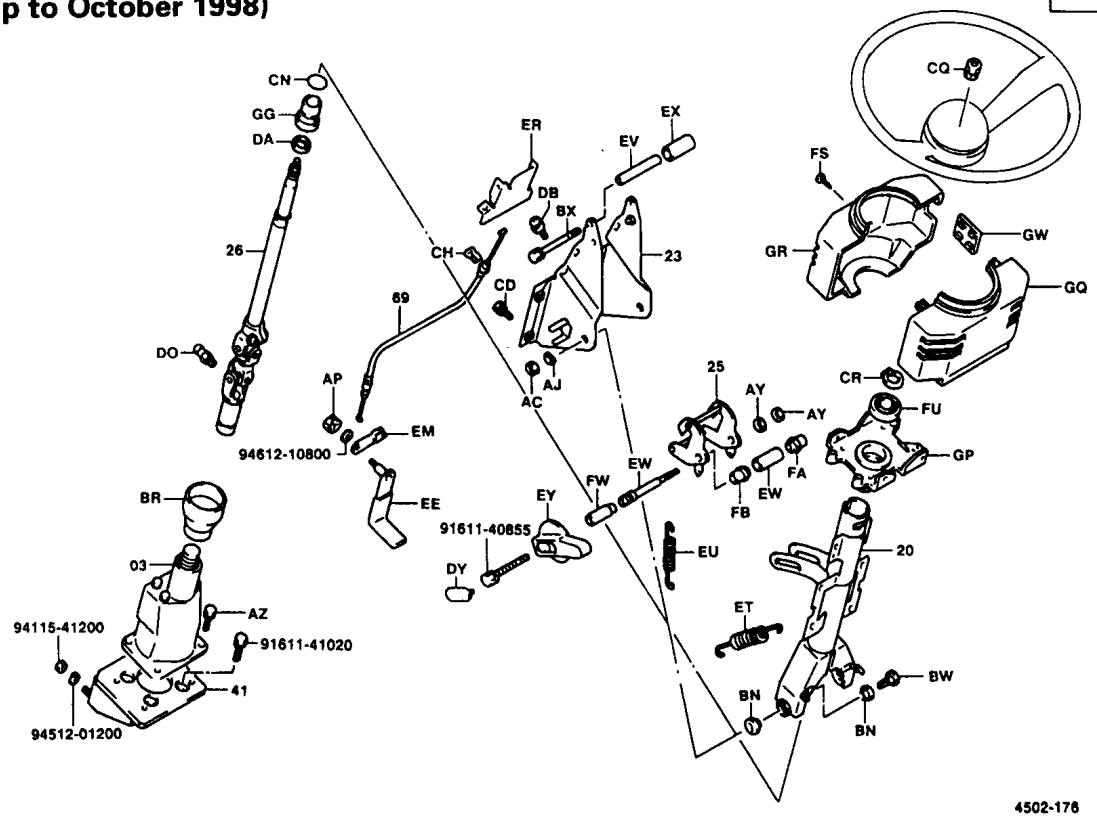
4501



4501-040C

4502

(Up to October 1998)



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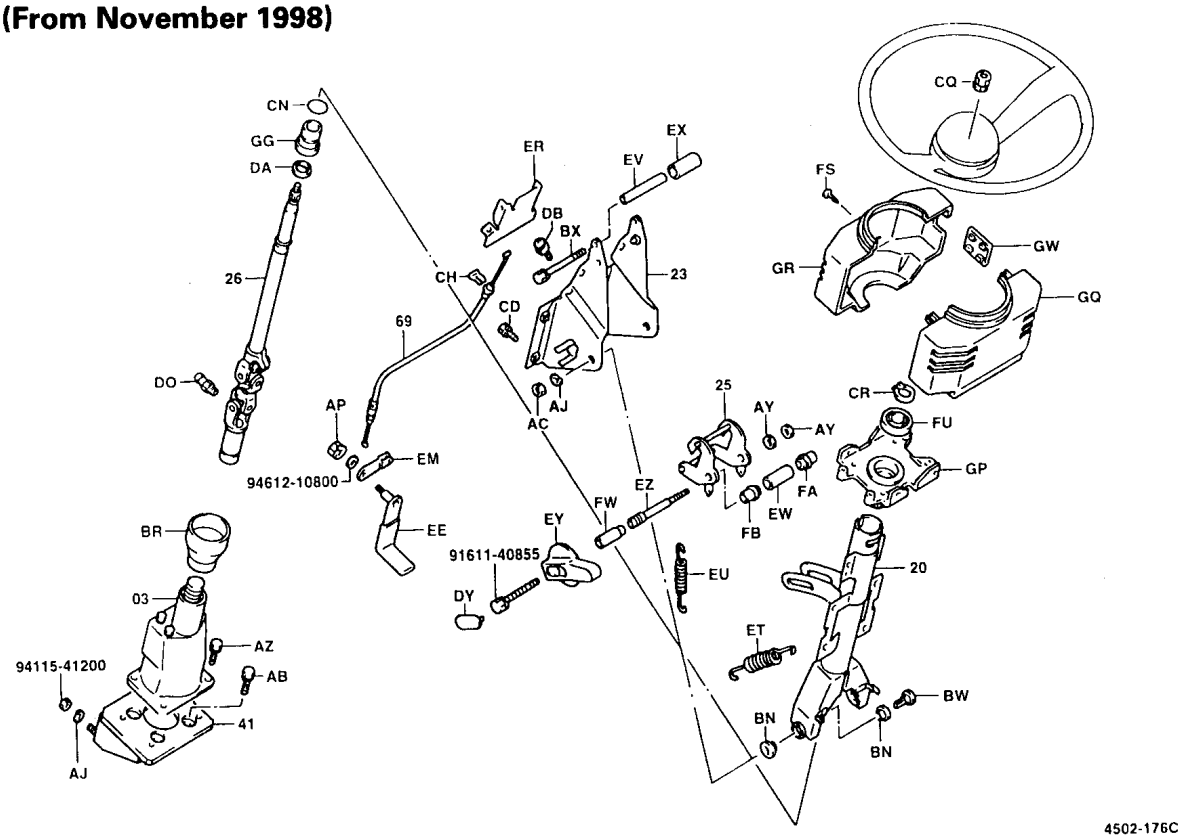
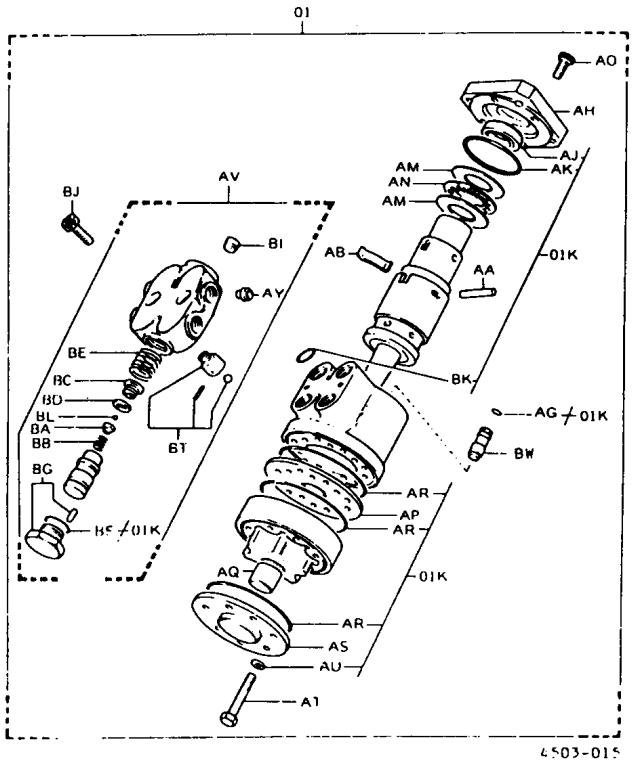


4503

(Up to October 1998)



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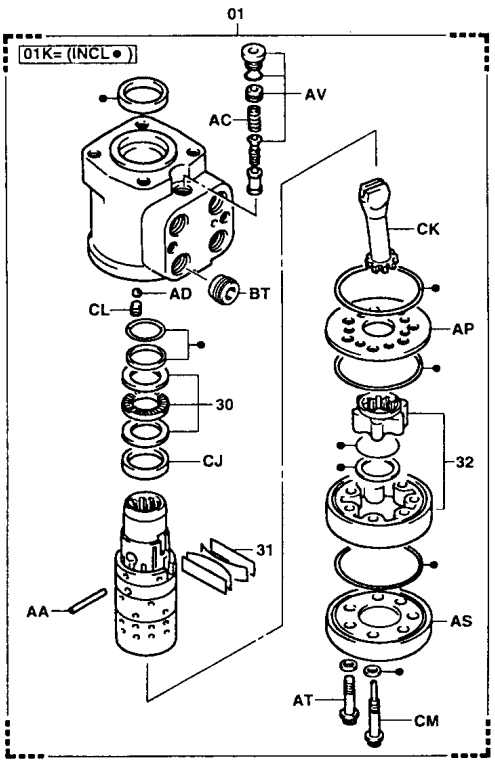

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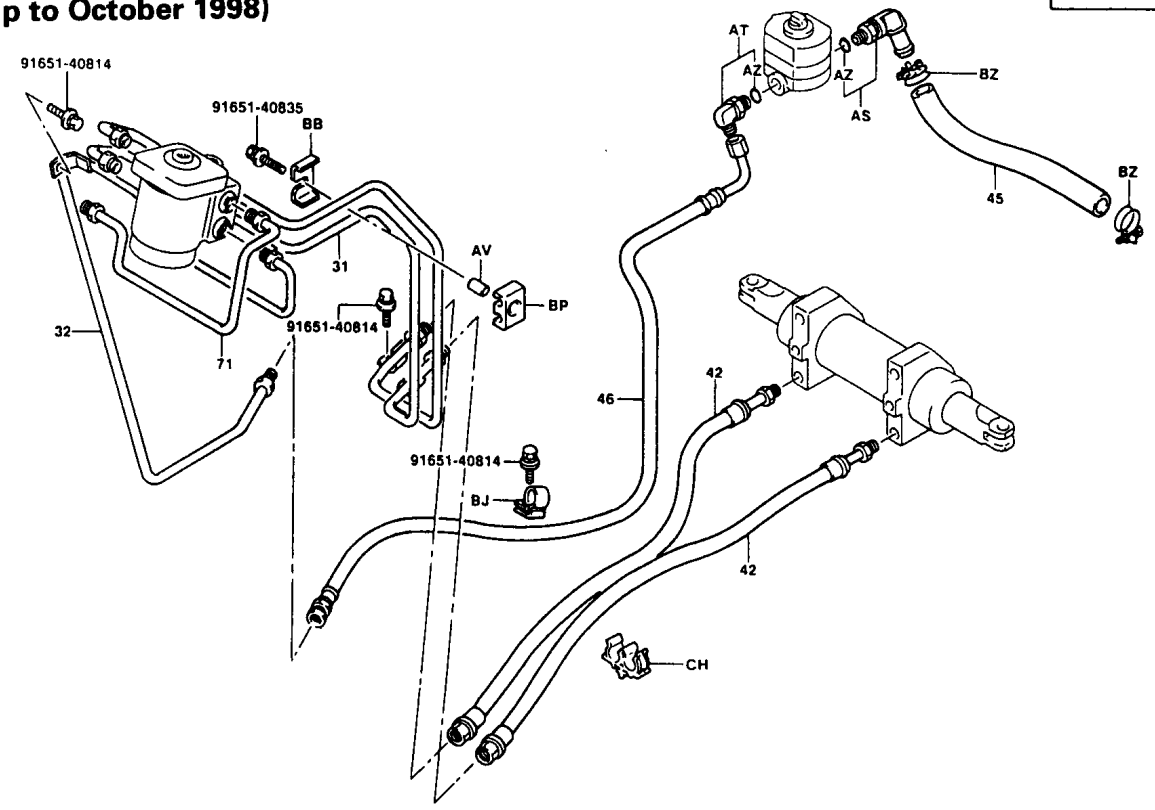
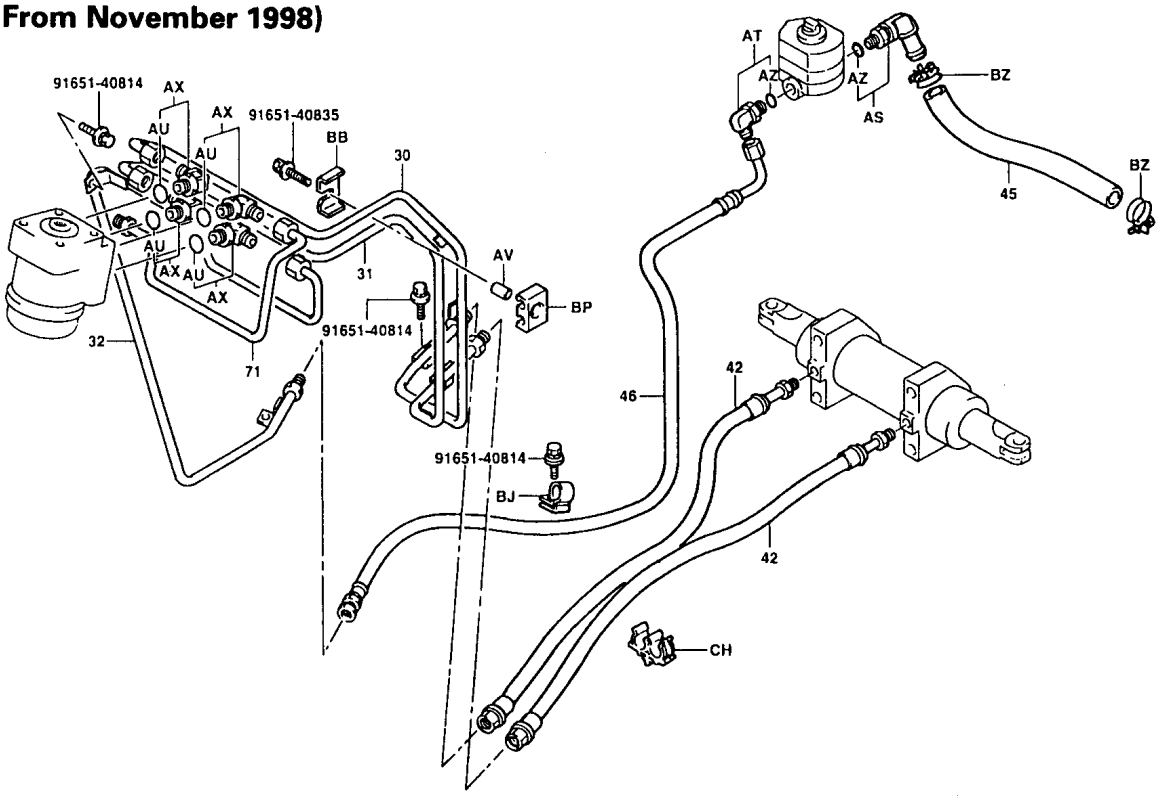
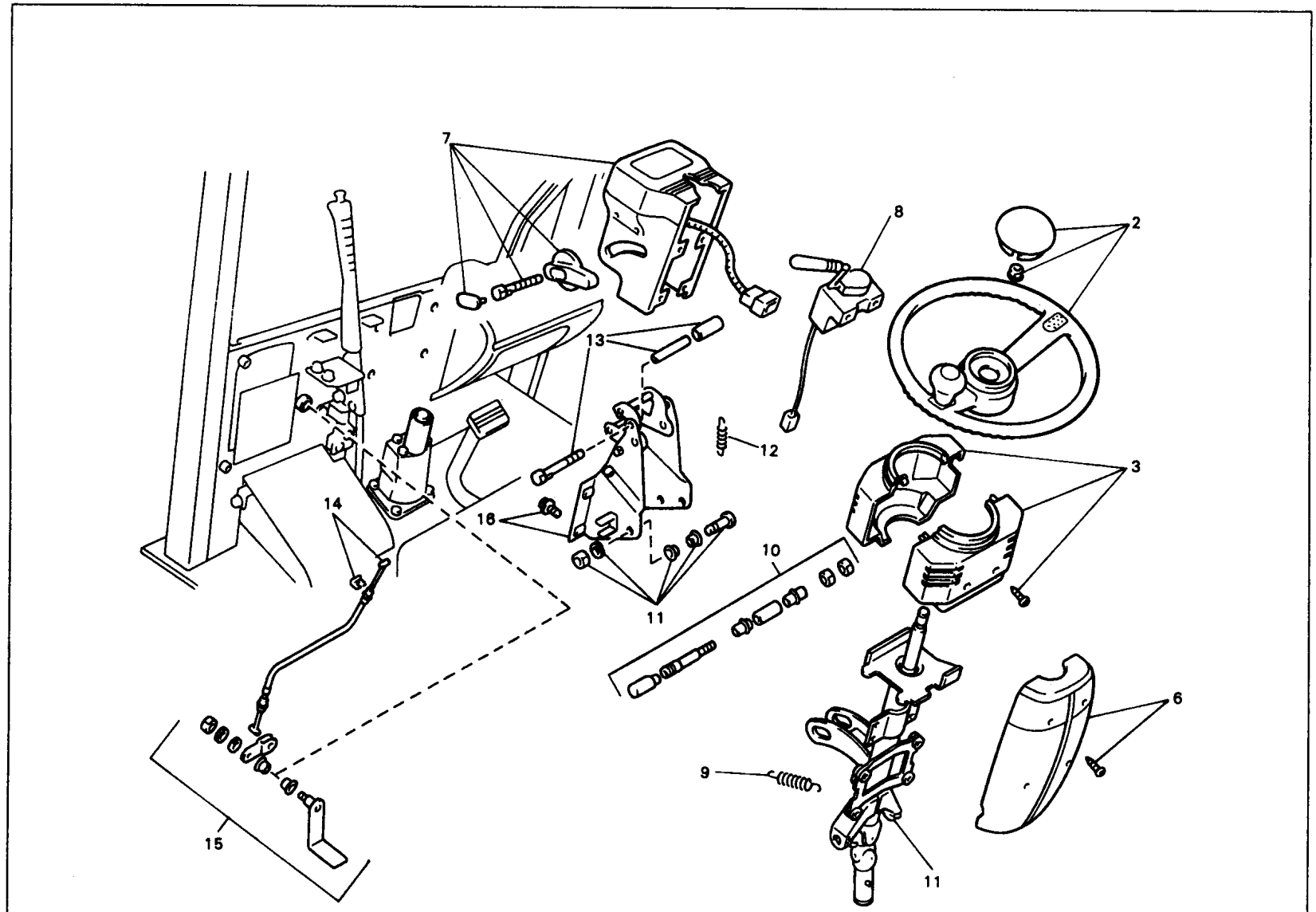


4507-148

(From November 1998)



4507-168



1 Battery plug
4 Turn signal switch
5 Instrument panel

Removal Procedure

1 Disconnect the battery plug.

2 Remove the steering wheel. **[Point 1]**

3 Remove the turn signal switch covers. **[Point 2]**

4 Remove the turn signal switch ASSY.

5 Remove the instrument panel.

6 Remove the rear cover.

7 Remove the display ASSY.

8 Remove the direction switch.

9 Remove the return spring.

10 Remove the tilt lock components. **[Point 3]**

11 Remove the mast jacket ASSY.

12 Remove the small spring.

13 Remove the pipe W/hose.

14 Disconnect the tilt steering wire from the bracket.

15 Remove the tilt steering wire and release lever.

16 Remove the tilt steering bracket.

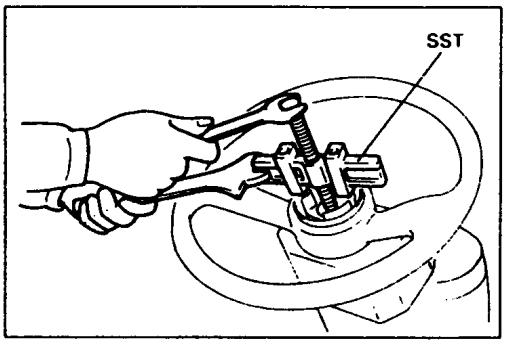
Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
- **Coat MP grease on the tilt lock device and each sliding contact portion.**
- **Add MP grease through the grease fitting of the steering universal joint.**
- **The tightening torque for each portion is as follows:**

Unit: N·m (kgf-cm) [ft-lbf]

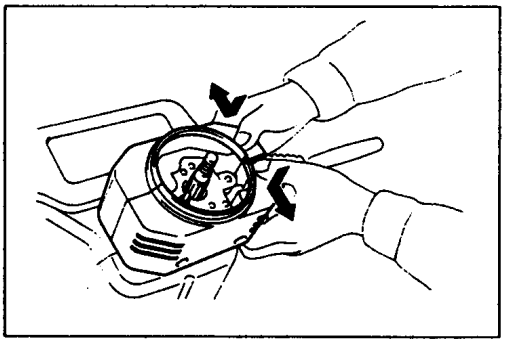
Steering universal joint set bolt	17.65 ~ 24.52 (180 ~ 250) [13.02 ~ 18.09]
Mast jacket set nut	34.32~53.94 (350~550) [25.32~39.79]
Steering wheel set nut	19.61 ~ 29.42 (200 ~ 300) [14.47 ~ 21.71]



Point Operations

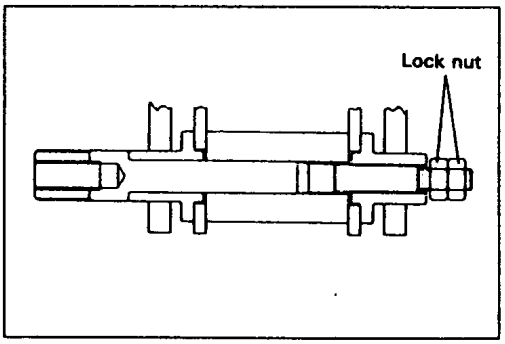
[Point 1]

Removal: SST 09950-76001-71 (SST 09950-50010)



[Point 2]

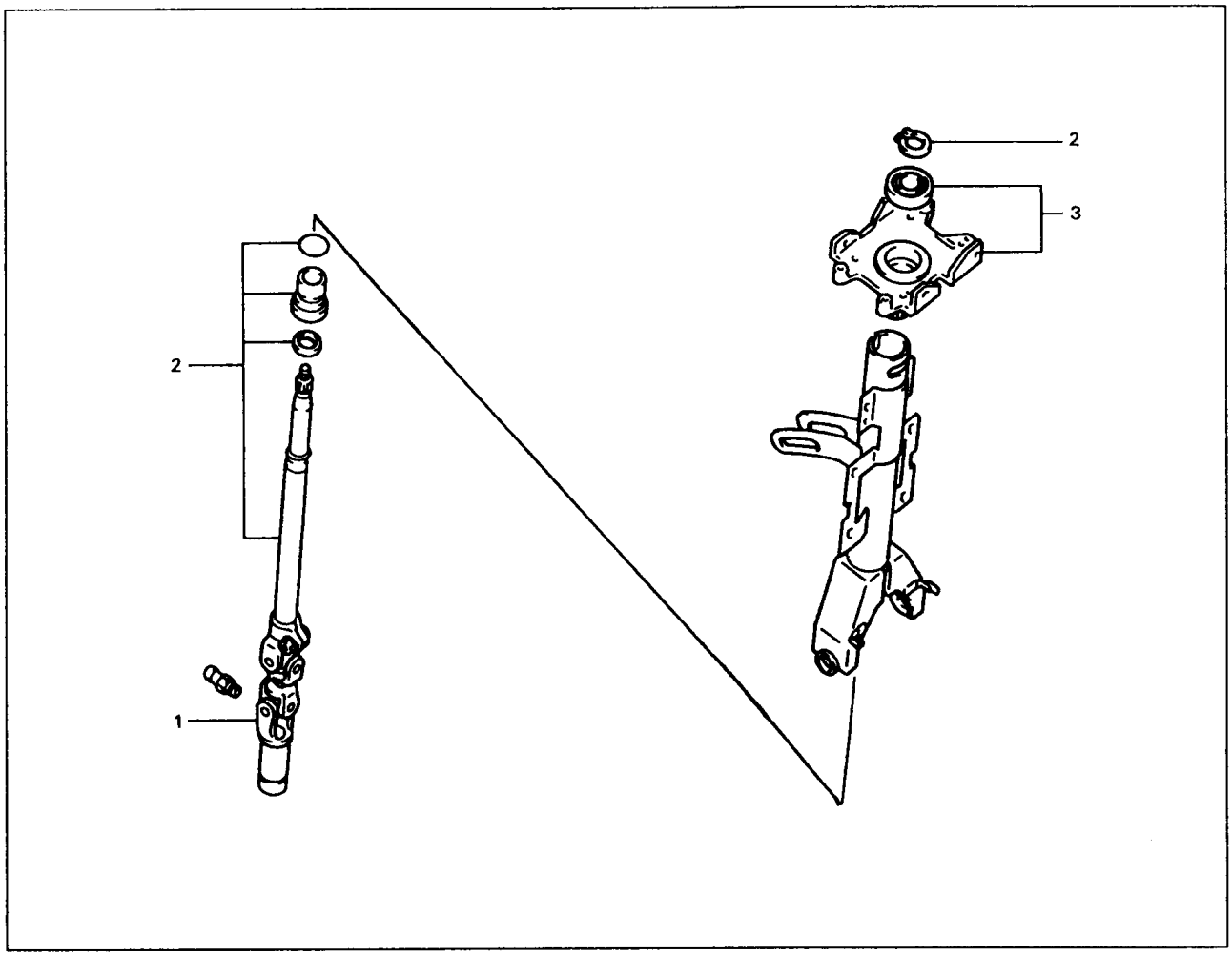
Removal: After removing the set screws, remove while pushing the cover as illustrated.



[Point 3]

Installation: After fully tightening the adjust nut, loosen it by one turn and lock it with the lock nut.

DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

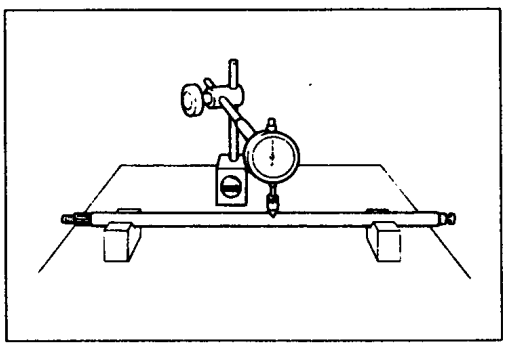
1 Remove the universal joint.

2 Remove the steering shaft. **[Point 1]**

3 Remove the turn signal switch bracket.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.



Point Operation

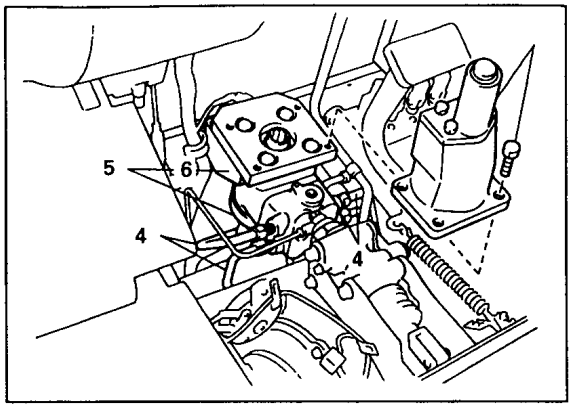
[Point 1]

Inspection: Inspect the steering shaft bend.
Bend limit: 1.5 mm (0.059 in)

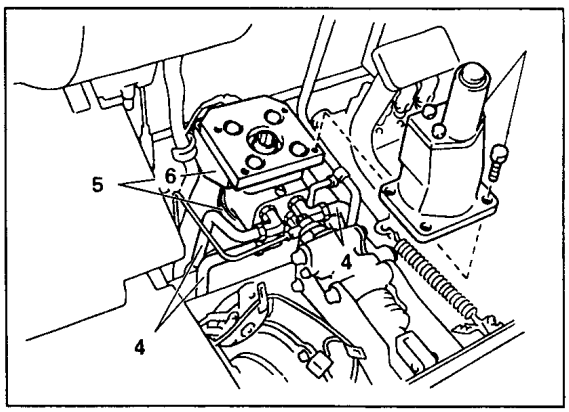
HYDROSTATIC STEERING VALVE ASSY

REMOVAL·INSTALLATION

(Up to October 1998)



(From November 1998)



1 Battery plug

2 Toe board

Removal Procedure

1 Disconnect the battery plug.

2 Remove the toe board.

3 Remove the torque sensor.

4 Disconnect the pipes.

5 Remove the steering valve W/bracket.

6 Remove the bracket from the steering valve.

Installation Procedure

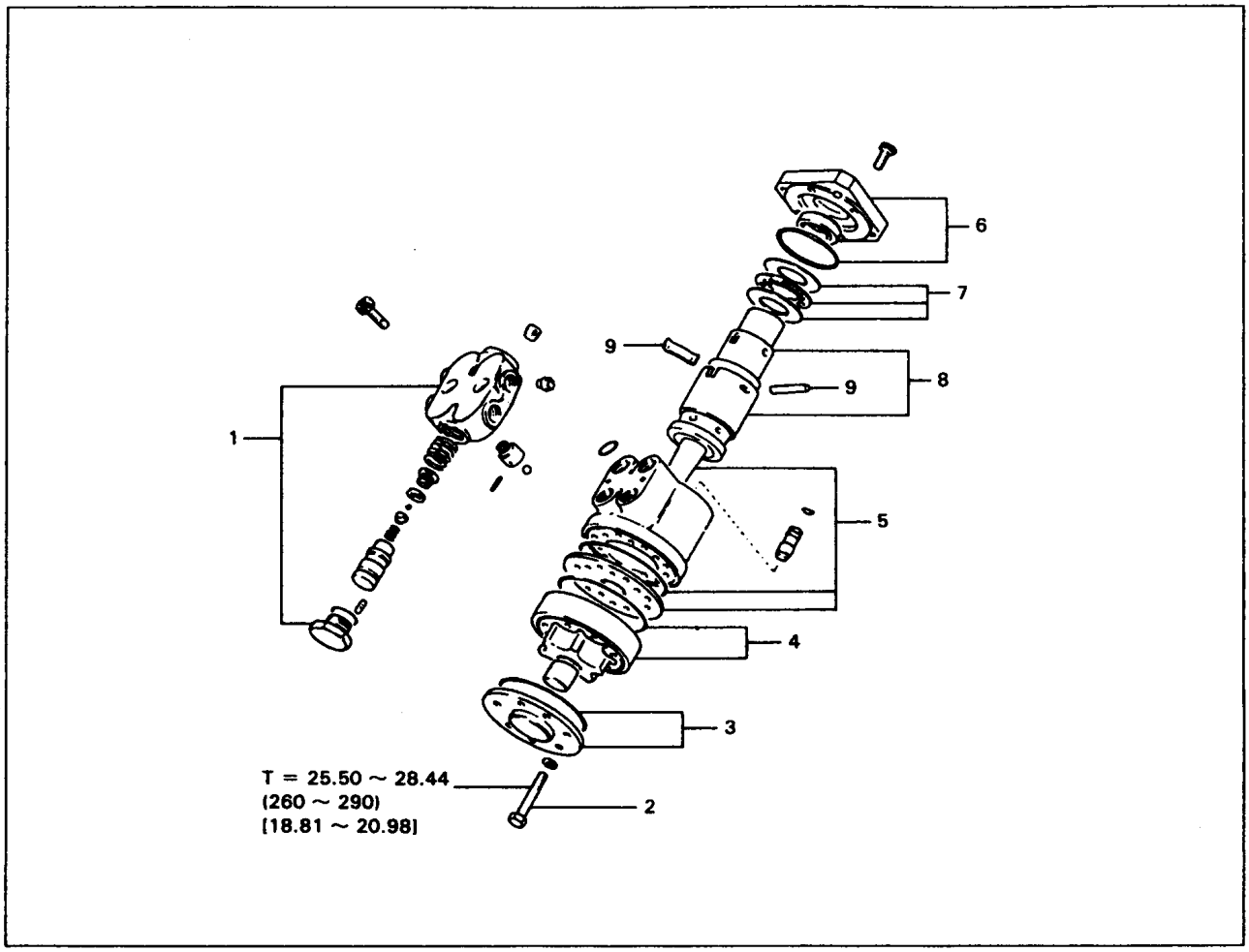
The installation procedure is the reverse of the removal procedure.

Note:
The tightening torque for each portion is as follows:

Steering valve bracket: 29 ~ 39 N·m (300 ~ 400 kgf-cm) [22 ~ 29 ft-lbf]

DISASSEMBLY·INSPECTION·REASSEMBLY (Up to October 1999)

N·m (kgf-cm) [ft-lbf]



Disassembly Procedure

1 Remove the relief valve.

2 Remove the end cap set screws. **[Point 1]**

3 Remove the end cap and O-ring. **[Point 2]**

4 Remove the rotor set, spacer and O-ring. **[Point 3]**

5 Remove the drive, spacer, plate and O-ring. **[Point 4]**

6 Remove the mounting plate, packing and O-ring. **[Point 5]**

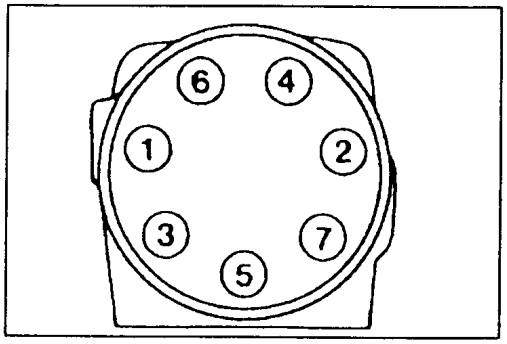
7 Remove the needle bearing and bearing race.

8 Remove the spool and sleeve ASSY.

9 Remove the centering spring. **[Point 6]**

Reassembly Procedure

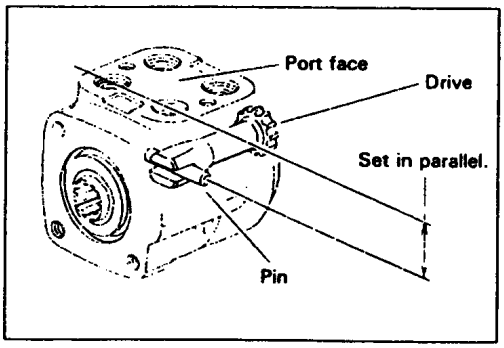
The reassembly procedure is the reverse of the disassembly procedure.



Point Operations

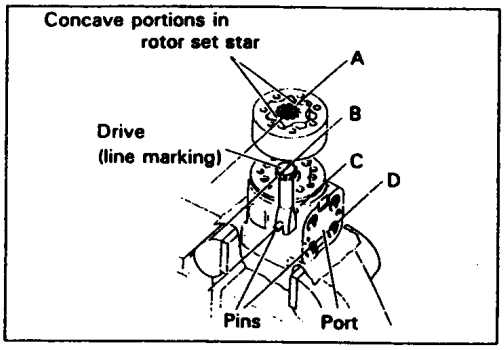
[Point 1]

Reassembly: Tighten the screws in the sequence illustrated at left.



[Point 2]

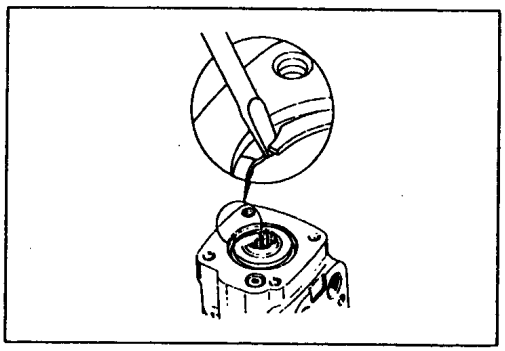
Reassembly: Set the concave portion of the rotor set star in parallel.



[Point 3]

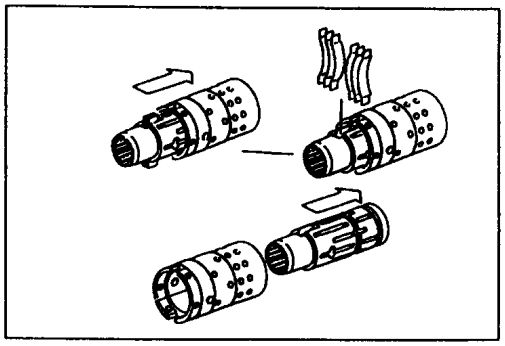
Reassembly: Insert the drive. For accurate positioning by fitting the yoke and pin, mark a line with a felt pen.

Reassembly: Confirm that A, B, C and D portions are parallel as illustrated at left.



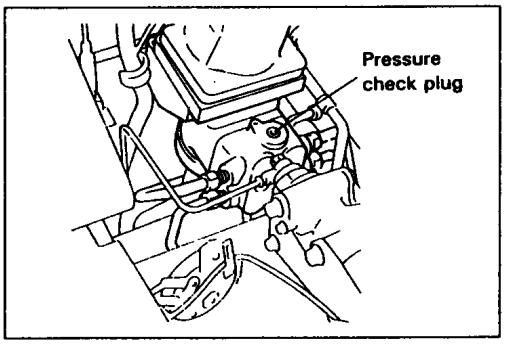
[Point 4]

Disassembly: Remove the retaining ring with a straight-edge screwdriver.



[Point 5]

Reassembly: Set springs back to back with the notched portions at both ends facing downward.



RELIEF PRESSURE MEASUREMENT

1. Measure the power steering relief pressure.

   (1) Remove the pressure check plug, and set an oil pressure gage.
   Plug size: PT 1/4

   (2) With the key switch ON, turn the steering wheel slowly clockwise and counterclockwise.

   (3) Rotate the steering wheel and measure the relief pressure when the relief occurs.

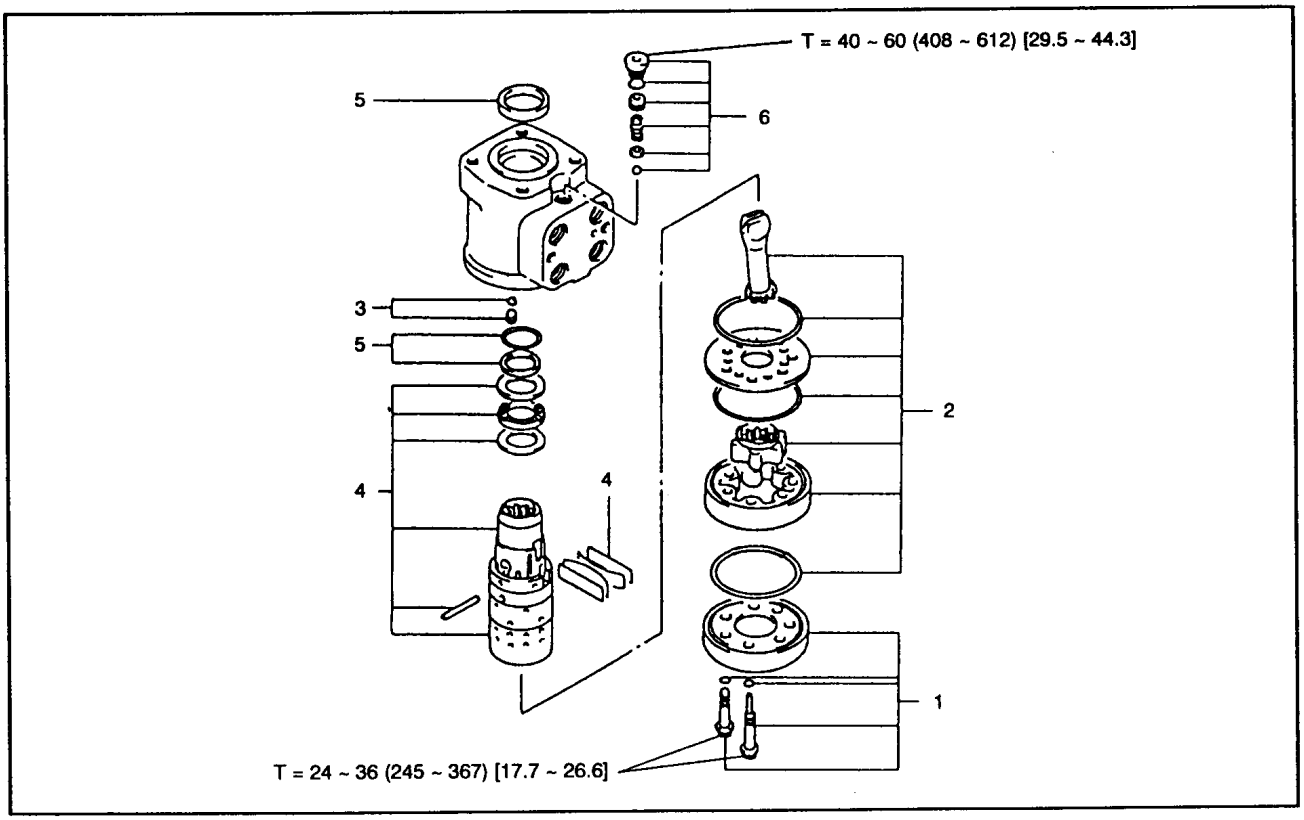
   Standard relief pressure:
   FBMF16
   5390 ~ 6370 kPa (55 ~ 65 kgf/cm^2) [780 ~ 920 psi]
   FBMF20·25·30
   7350 ~ 8340 kPa (75 ~ 85 kgf/cm^2) [1070 ~ 1210 psi]

   (4) If the relief pressure is not within the standard, select the adjusting shim(s).

   Shim thickness:
   0.1·0.2 and 0.5 mm
   (0.004·0.008 and 0.020 in)

DISASSEMBLY·INSPECTION·REASSEMBLY (From November 1998)

T = N·m (kgf-cm) [ft-lbf]



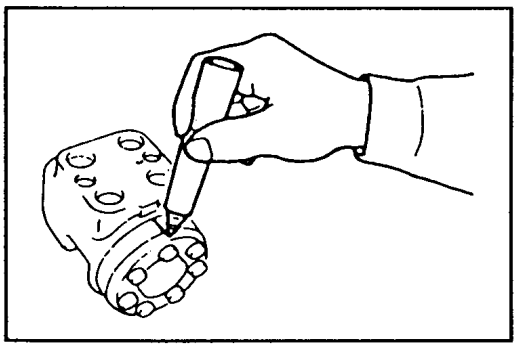
Disassembly Procedure

1 Remove the end cover. **[Point 1]**
2 Remove the gear wheel set, cardan shaft and distributor plate. **[Point 2]**
3 Remove the check valve.
4 Remove the sleeve W/spool and bearing. **[Point 3]**
5 Remove the O-ring, kin-ring and dust seal ring. **[Point 4]**
6 Remove the rerief valve. **[Point 5]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

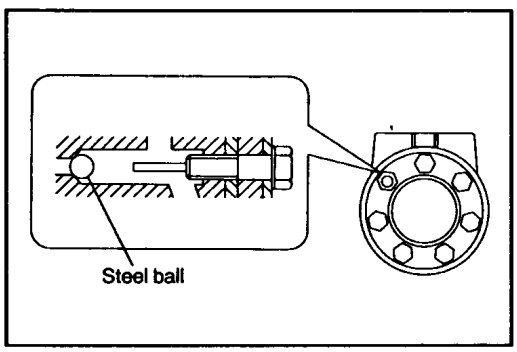
Note:
Wash each part with clean hydraulic oil before assembly.



Point Operations

[Point 1]
Disassembly:
Put a match mark.

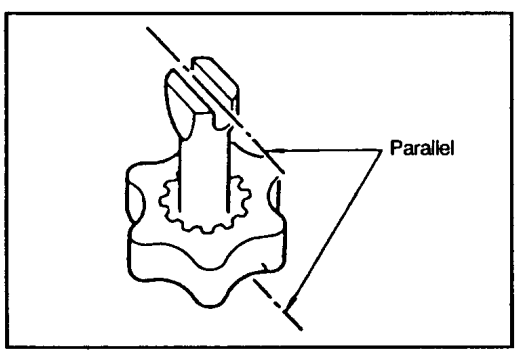
Reassembly:
Align the match marks.



Disassembly:
When removing each set bolts, carefully operate so as not to lose the steel ball.

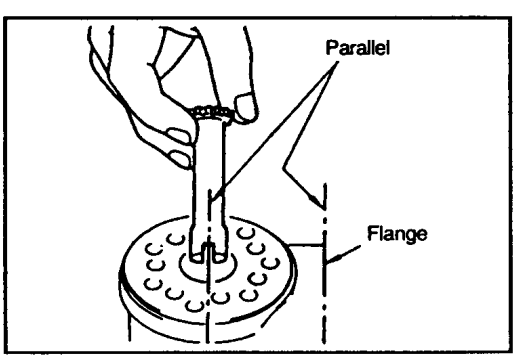
Reassembly:
Put a steel ball in the illustrated position before installing each set bolts.

Reassembly:
As one out of seven set bolts is a bolt with pin, install it in the correct position.

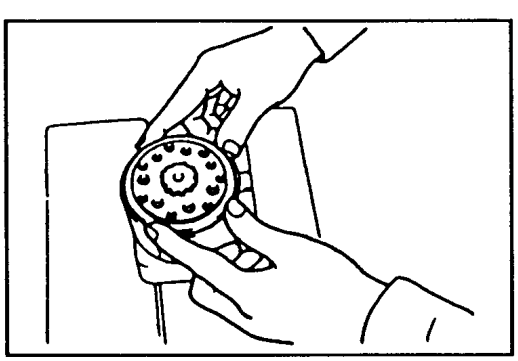


[Point 2]
Reassembly:
Pay attention to the following points at the time of reassembly.

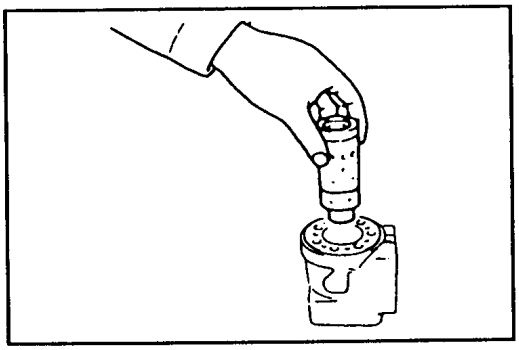
1. Fit the gearwheel (rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through holes match the holes in the housing.



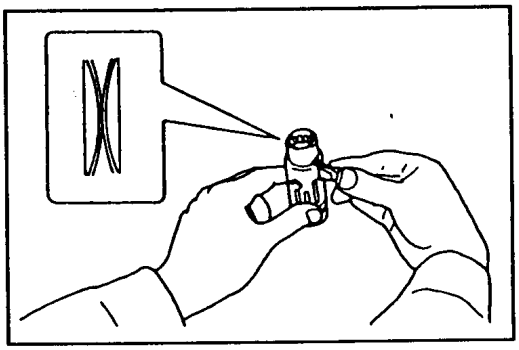
2. Guide the carden shaft down into the bore so that the slot is parallel with the connection flange.



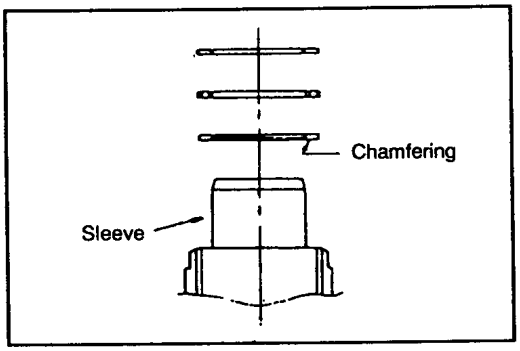
3. Align the match marks on the distributor plate and gear wheel made at the time of disassembly.
When these parts are replaced, match the holes in the housing and plate at the time of reassembly.



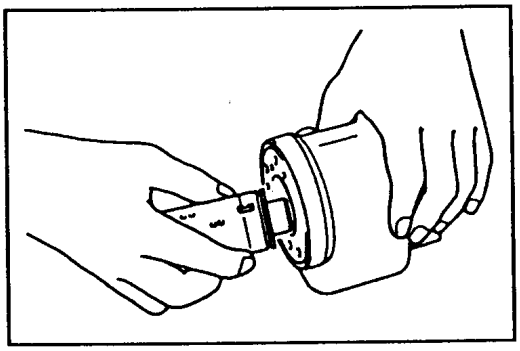
[Point 3]
Disassembly:
Extract the spool W/sleeve upward. Otherwise, the spool cross pin may move during extraction to cause sticking.



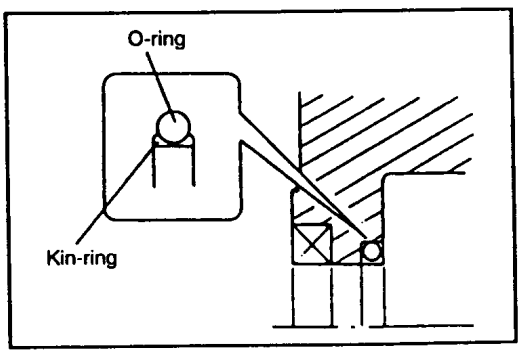
Reassembly:
Set and install the neutral position spring correctly.



Reassembly:
Pay attention to the bearing direction for installation. (See the figure.)

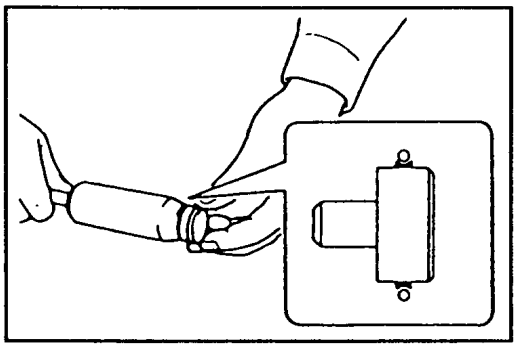


Reassembly:
Place the housing with its flanged side facing down, and insert the spool W/sleeve into the housing. Set the cross pin of the spool in horizontal state during insertion.

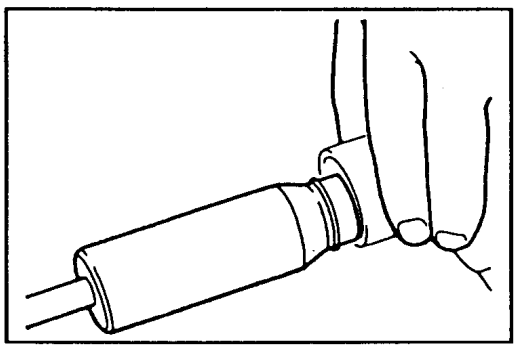


[Point 4]
Reassembly:
Install the kin-ring and O-ring correctly.

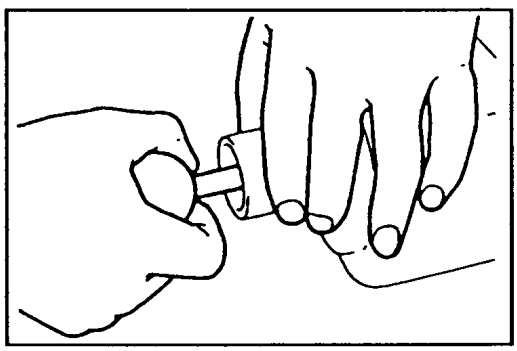
Note:
For SST No. SJ150-9000-11, please inquire at the nearest Danfoss service shop.
(Refer to Parts & Service News Ref. No. GE-7022 of July 1, 1997 for detail.)



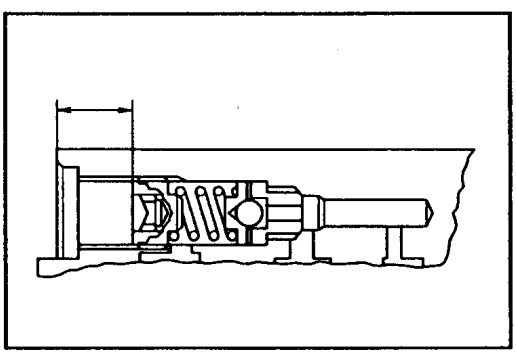
1. Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool/sleeve.
2. Apply O-ring and kin-ring with hydraulic oil and place them on the tool.



3. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



4. Press and turn the O-ring/kin-ring into position in the housing.
5. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



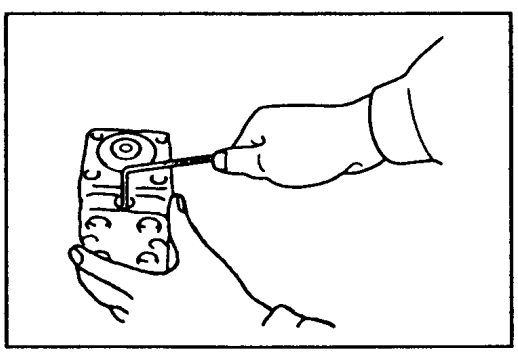
[Point 5]

Disassembly:

Do not remove the relief valve unless it is judged defective. The valve seat cannot be removed.

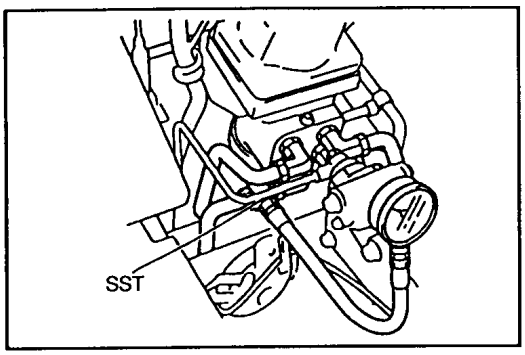
Disassembly:

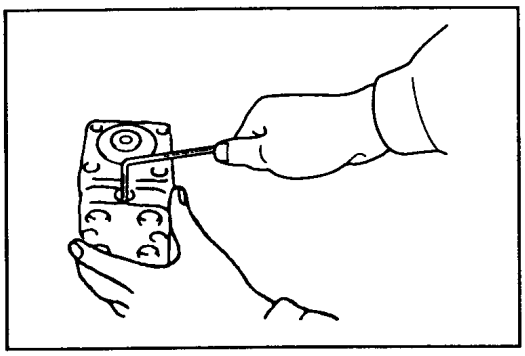
Measure the screwed-in depth of the relief valve adjusting screw before starting disassembly.



Reassembly:

Reassemble by adjusting to the screwed-in depth of the valve spring retainer measured before disassembly. After installing the steering valve ASSY on the vehicle, measure the relief pressure. If it is not within the standard range, adjust it by changing the screwed-in depth of the retainer.





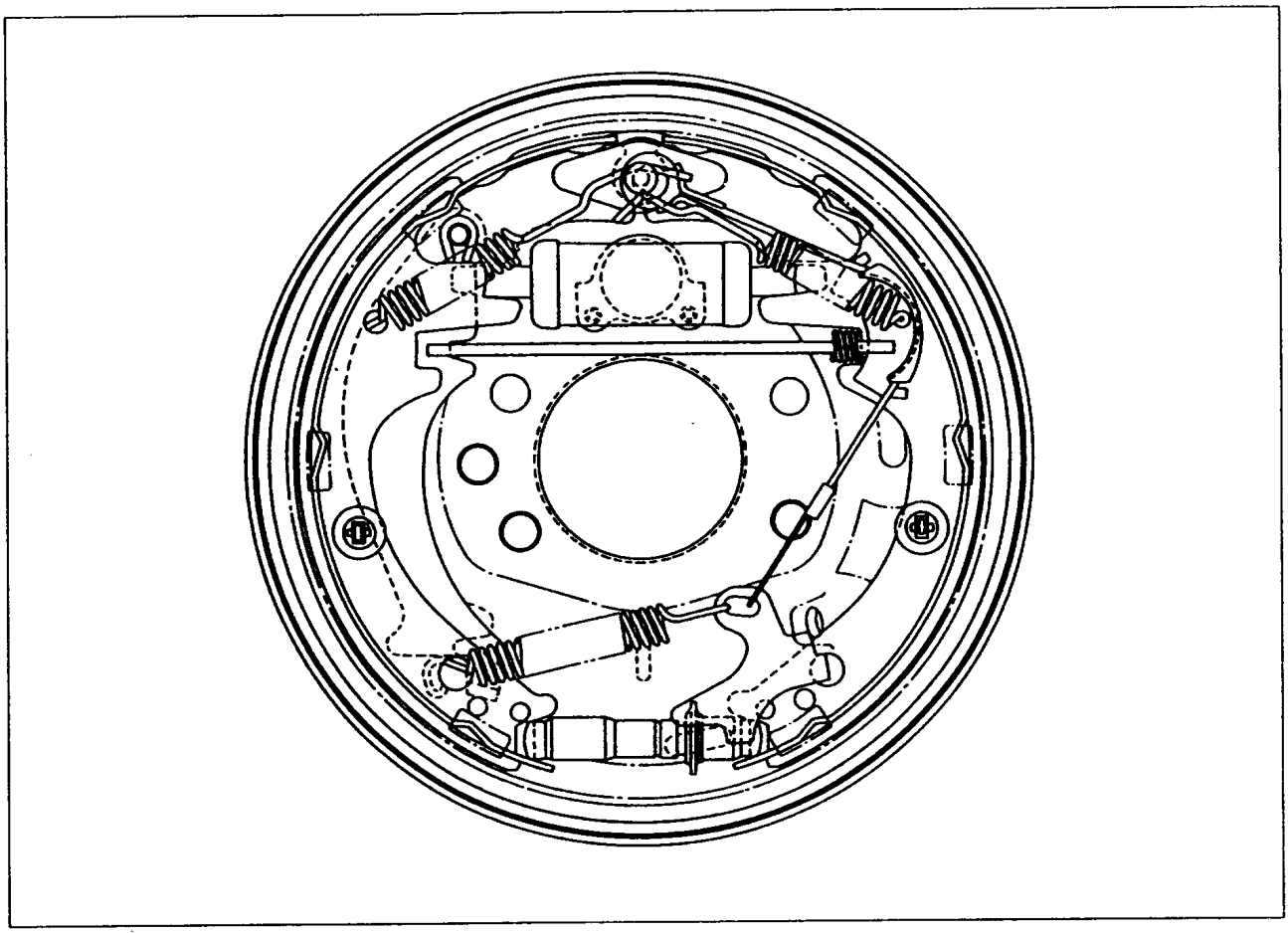
RELIEF PRESSURE MEASUREMENT

1. Measure the power steering relief pressure.
   (1) Disconnect the steering valve piping (at one place shown in the figure: pump port) and install the SST.
   SST 09450-23610-71
   Plug size: PT 1/8
   (2) With the key switch ON, turn the steering wheel slowly clockwise and counterclockwise.
   (3) Rotate the steering wheel and measure the relief pressure when the relief occurs.
   Standard relief pressure:
   7850 ± 49 kPa (80 ± 5 kgf/cm²) [1140 ± 70 psi]

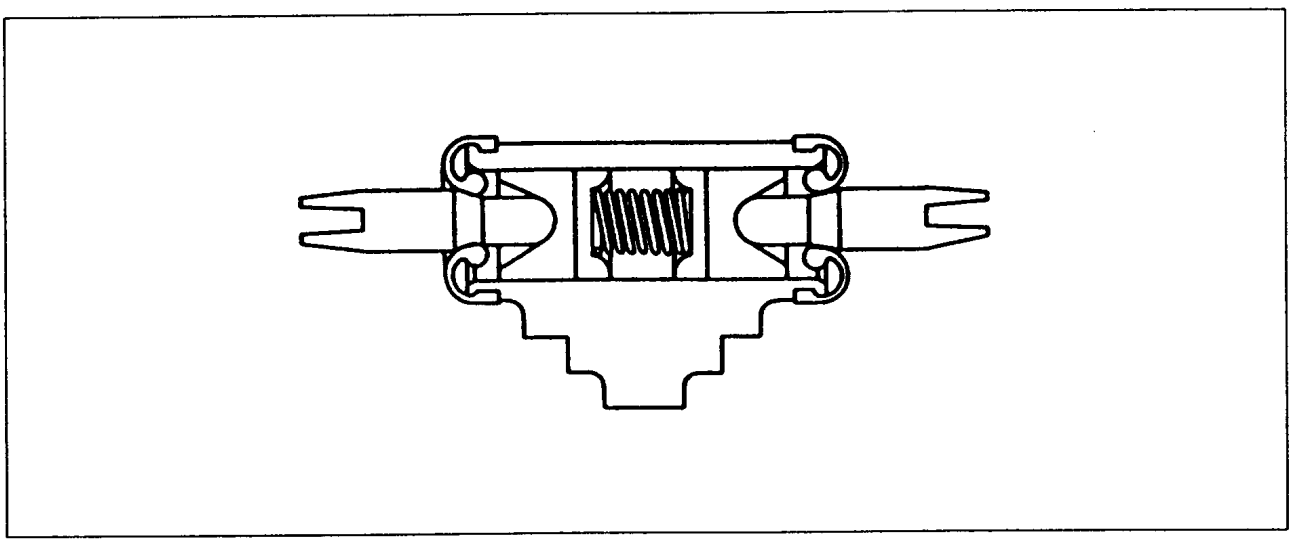
BRAKE

GENERAL

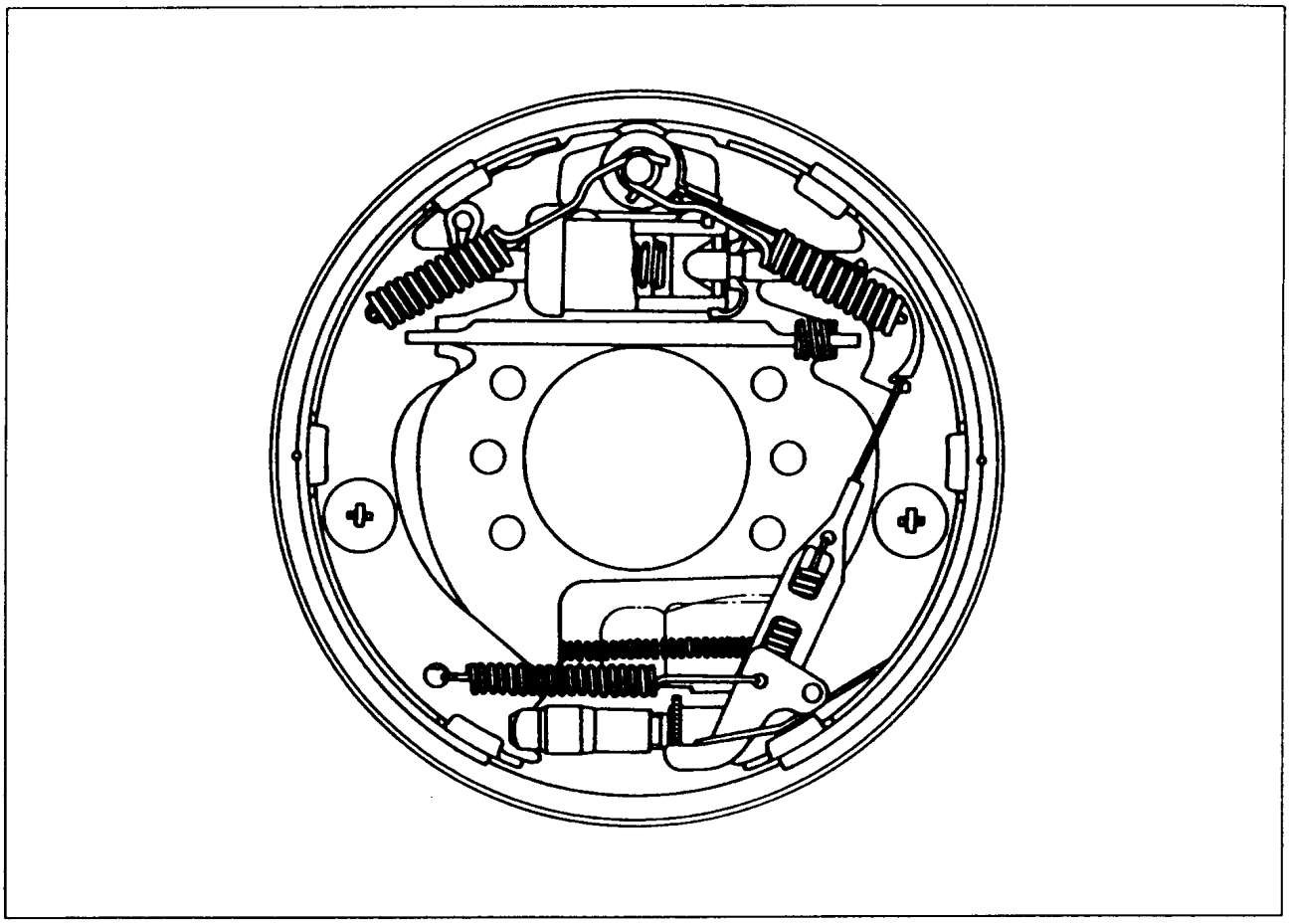
Front Brake (FBMF16)



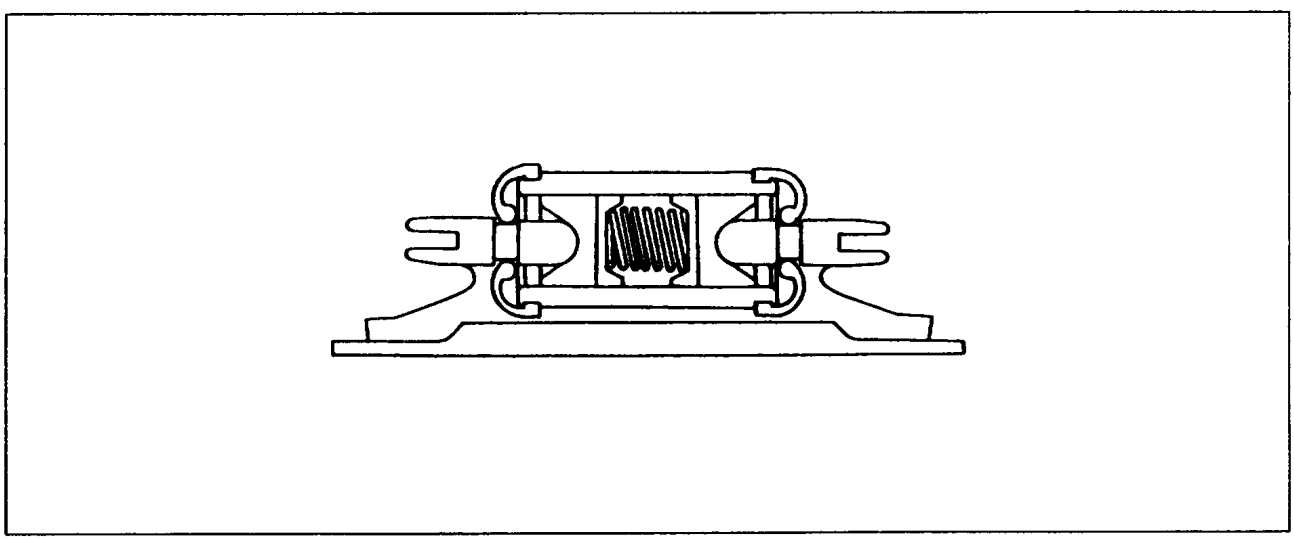
Wheel Cylinder (FBMF16)



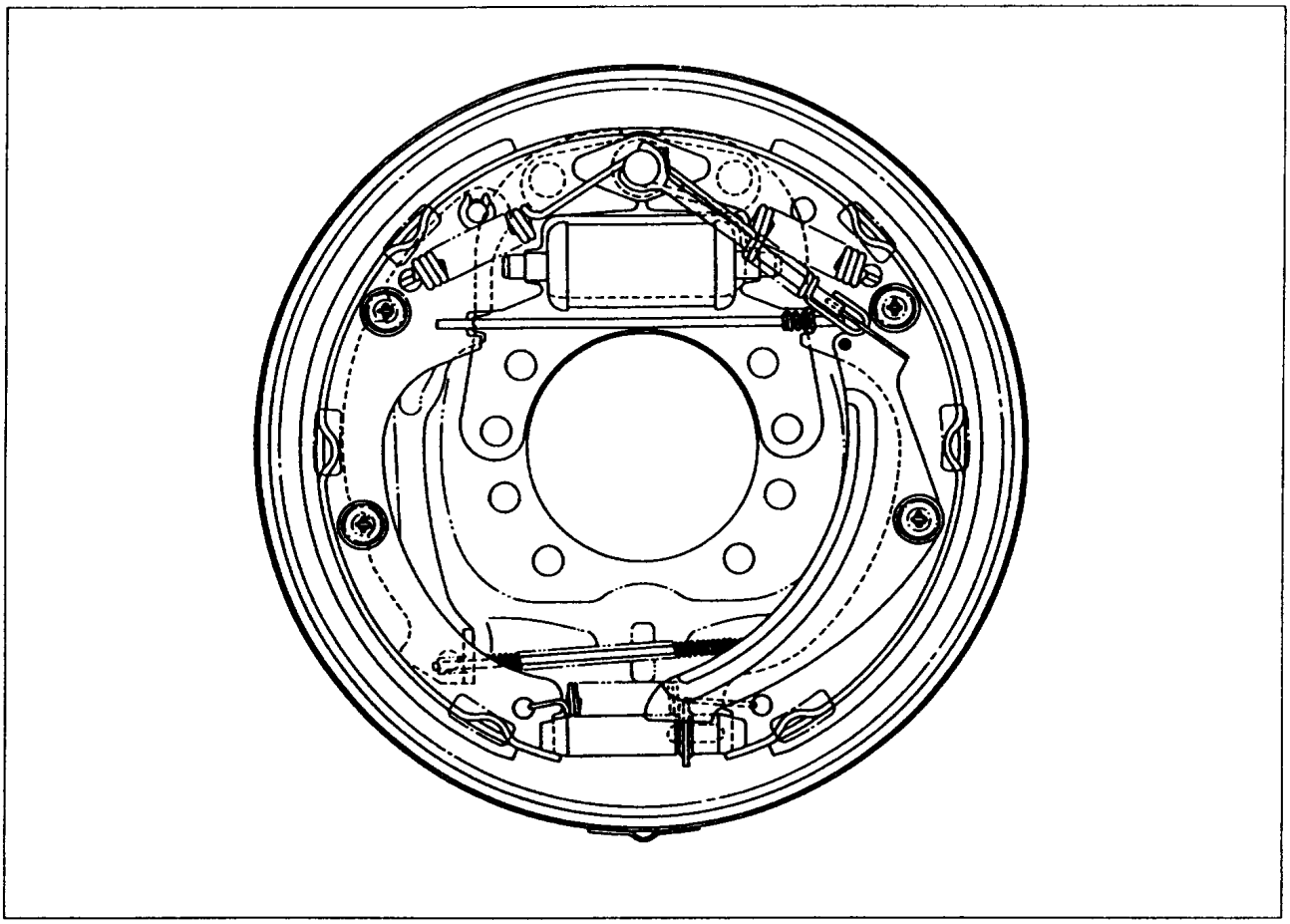
Front Brake (FBMF20,25)



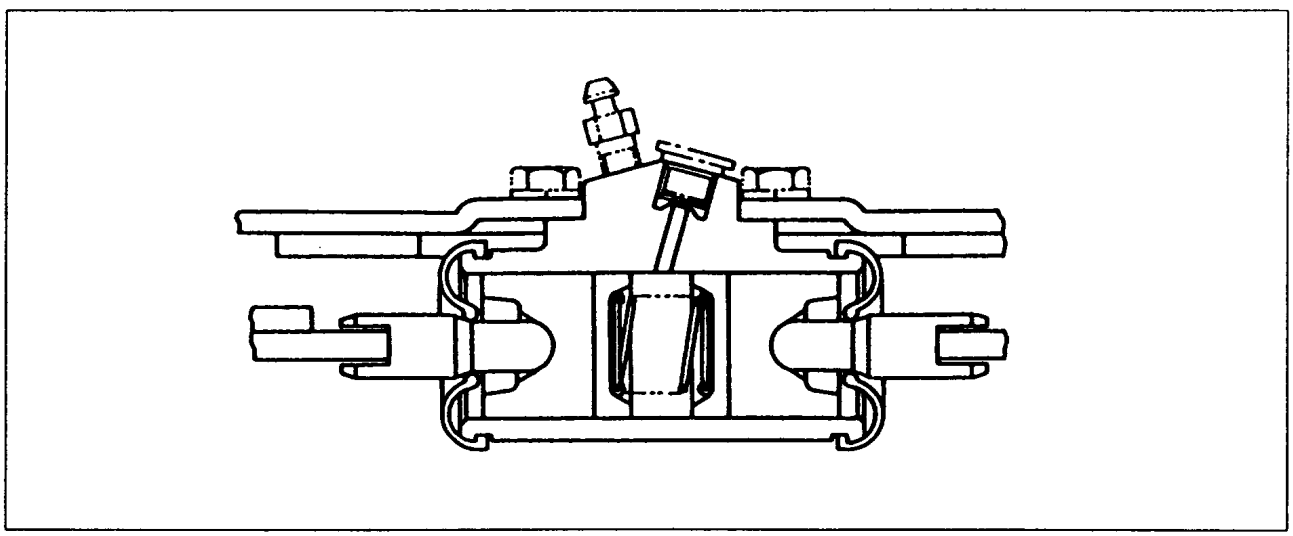
Wheel Cylinder (FBMF20,25)



Front Brake (FBMF30)



Wheel Cylinder (FBMF30)



SPECIFICATIONS

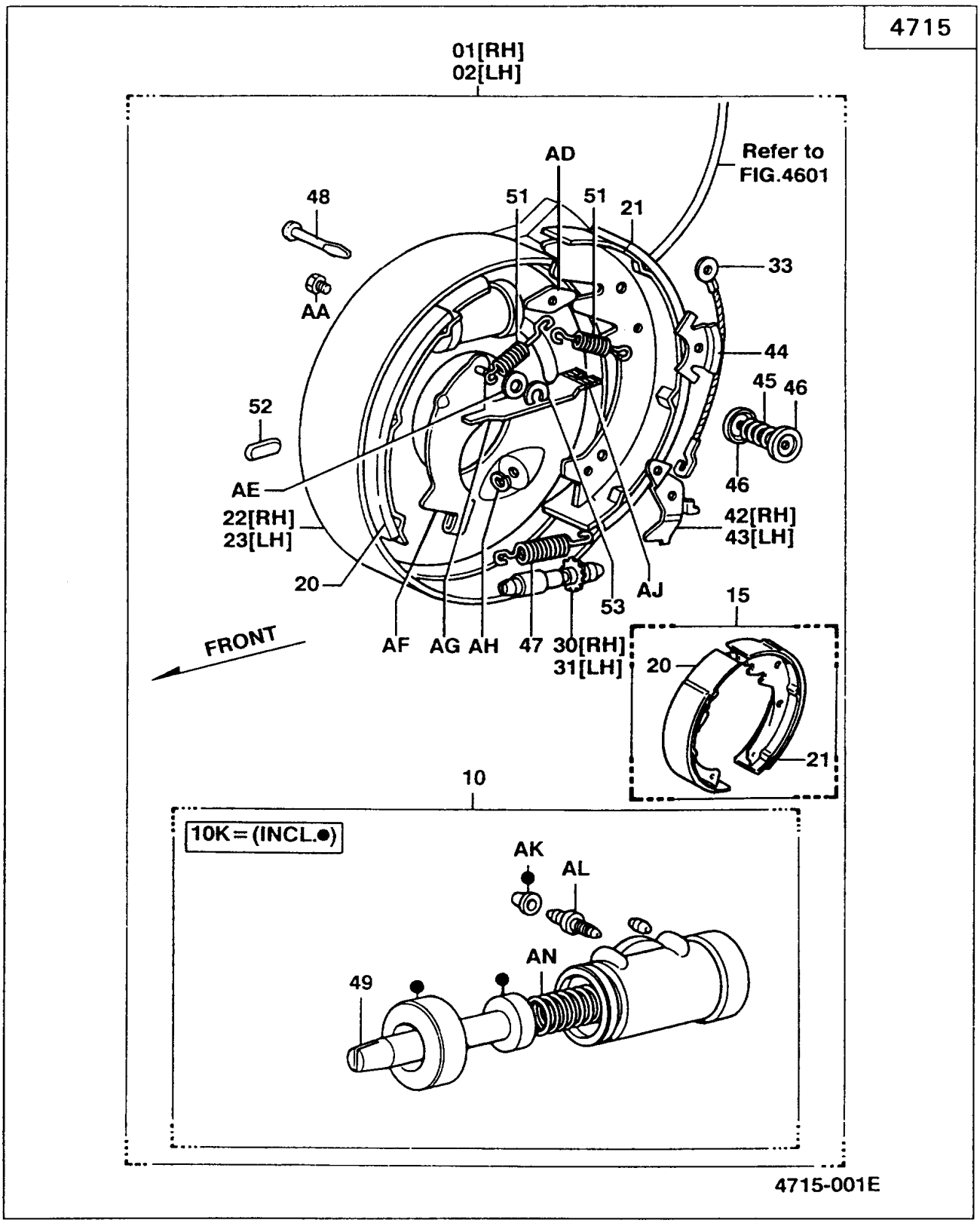
Unit: mm (in)

Item \ Model	FBMF16	FBMF20·25	FBMF30
Foot brake type	Hydraulic, internal expanding, duo-servo		
Brake drum inside diameter	254 (10.00)	279.4 (11.00)	310 (12.20)
Brake lining material	Molded resin (asbest-free)		
Brake lining dimensions: Thickness × width × length	4.87 × 48.5 × 279 (0.1917 × 1.909 × 10.98)	5.10 × 55.0 × 302 (0.2008 × 2.165 × 11.89)	7.0 × 60.0 × 343 (0.275 × 2.362 × 13.50)
Wheel cylinder bore	22.22 (0.8748)	25.40 (1.0000)	28.58 (1.1252)
Master cylinder bore	19.05 (0.7500)	←	25.40 (1.0000)

FRONT BRAKE

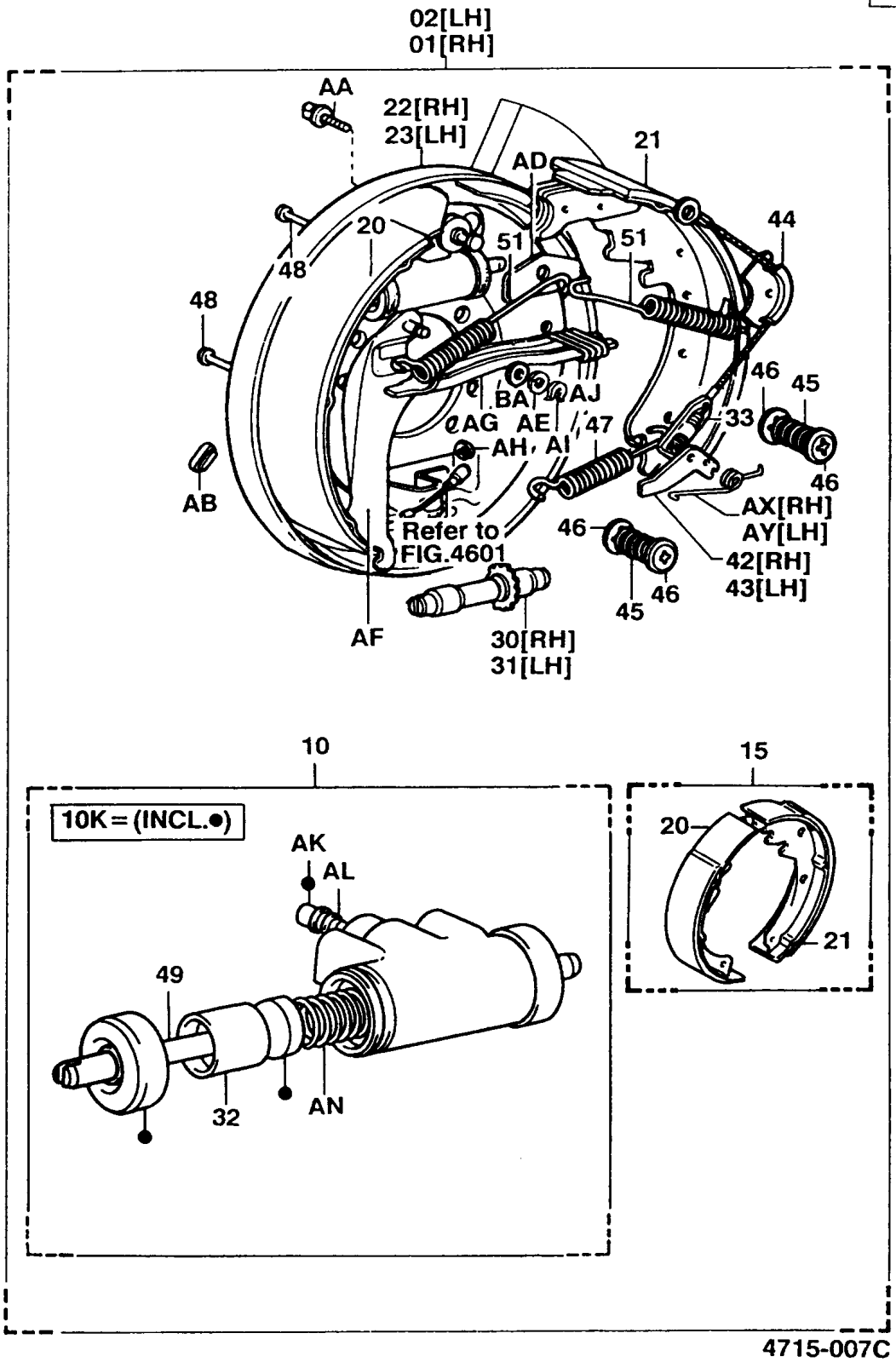
COMPONENTS

Brake Components (FBMF16)

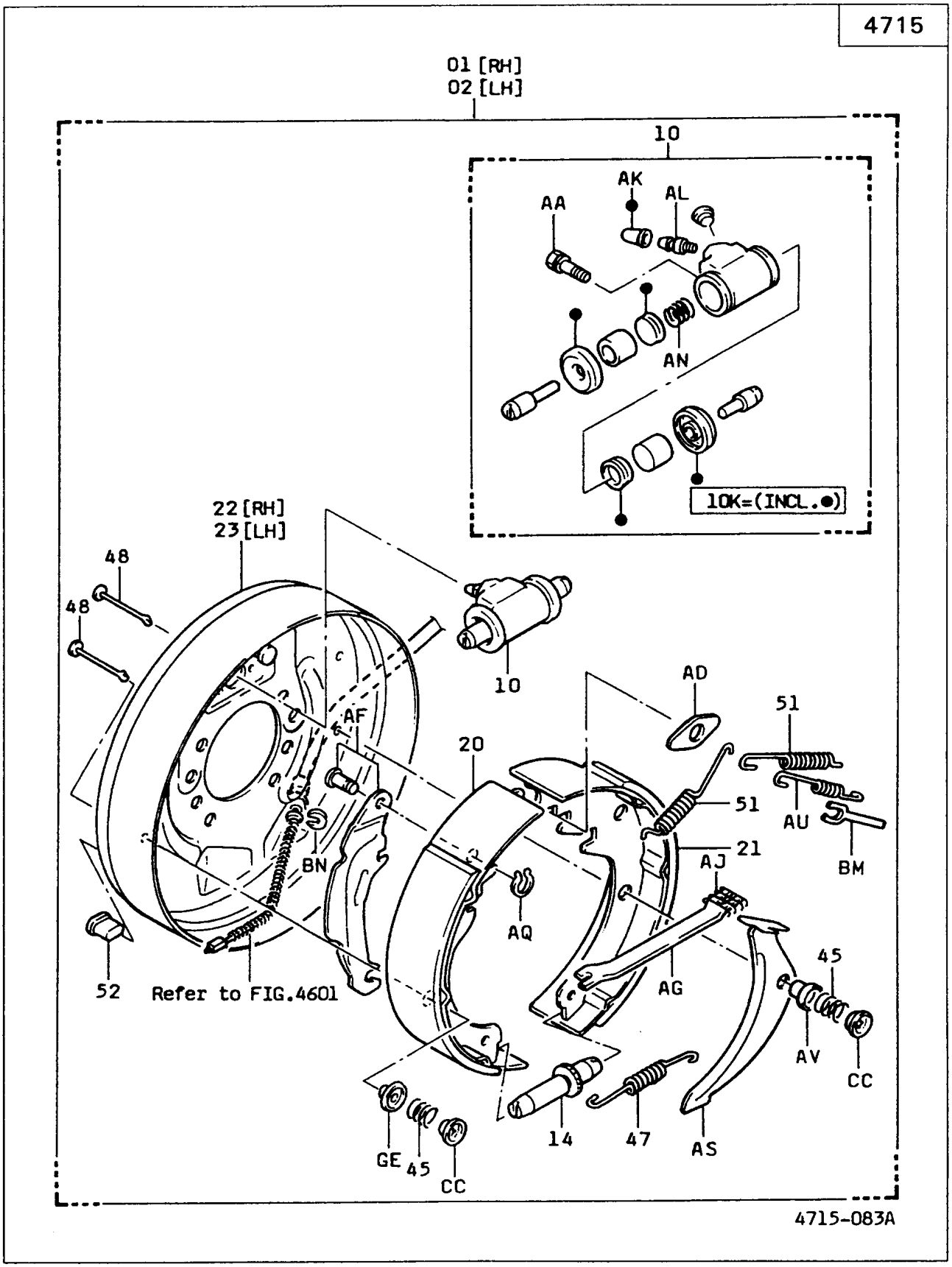


Brake Components (FBMF20,25)

4715

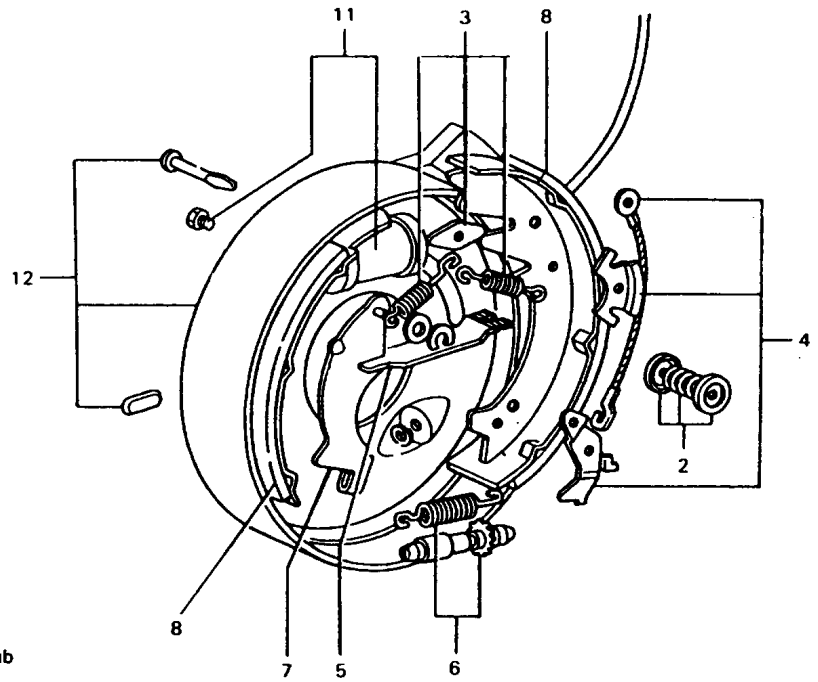


Brake Components (FBMF30)



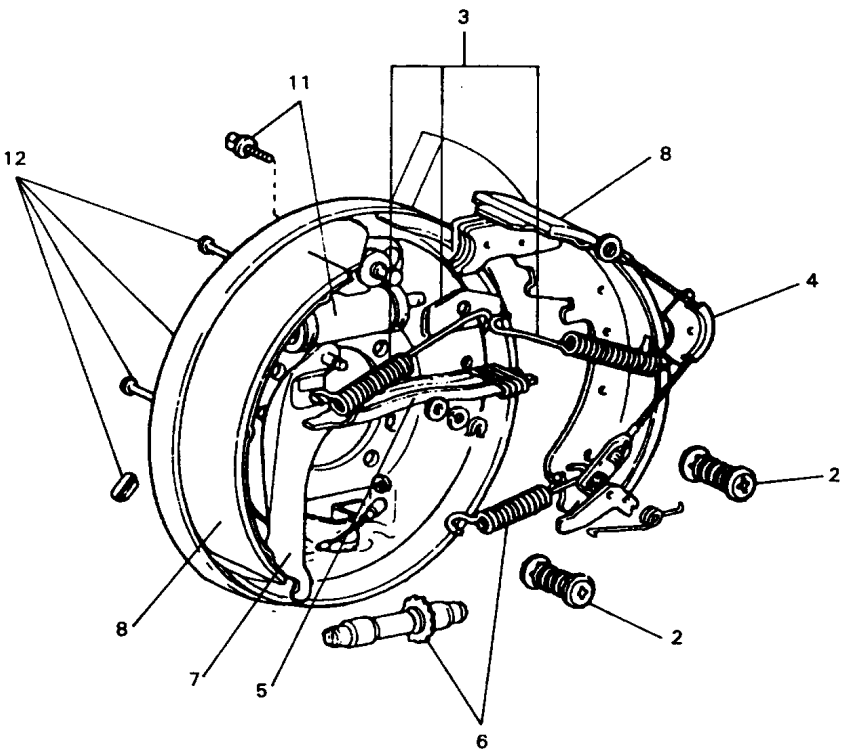
DISASSEMBLY·INSPECTION·REASSEMBLY (FBMF16,20,25)

FBMF16:



1 Front axle hub
9 Brake fluid
10 Brake pipe
13 Brake drum

FBMF20,25:



1 Front axle hub
9 Brake fluid
10 Brake pipe
13 Brake drum

Disassembly Procedure

1 Remove the front axle hub.
(See the front axle shaft, hub removal section on page 9-7.)

2 Remove the hold down spring. **[Point 1]**

3 Remove the anchor-to-shoe spring. **[Point 2]**

4 Remove the cable and cable guide.

5 Remove the strut lever. **[Point 3]**

6 Remove the adjuster spring and adjusting screw. **[Point 4]**

7 Disconnect the parking brake cable. **[Point 5]**

8 Remove the brake shoe. **[Point 6]**

9 Drain brake fluid.

10 Disconnect the brake pipe.

11 Remove the wheel cylinder ASSY. **[Point 7]**

12 Remove the backing plate. **[Point 8]**

13 Disconnect the brake drum from the hub. **[Point 9]**
(See the front axle shaft, hub removal section on page 9-7.)

Reassembly Procedure

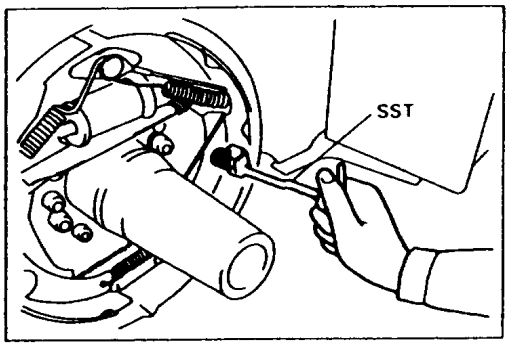
The reassembly procedure is the reverse of the disassembly procedure.

Note:

- **See the note for front axle shaft, hub installation. (See Page 9-8.)**
- **Check no oil or grease adhesion on the brake lining and interior surface of the brake drum before reassembly.**
- **Set the installed brake shoe outside diameter to the value below by tightening the adjusting screw before installing the hub W/brake drum. (Set to 1 mm (0.04 in) smaller than the brake drum inside diameter.)**
  Installed brake shoe outside diameter: FBMF16 253 mm (9.96 in)
  FBMF20, 25 278.9 mm (109.80 in)
- **Coat thread tightener (08833-00070) before tightening the brake drum set nuts. (Applicable when the hub and brake drum are disconnected.)**
- **Bleed air from the brake system after reassembly.**
- **Adjust the brake performance after reassembly. For adjustment, repeat forward travel and reverse travel of the vehicle, and stop the vehicle each time by depressing the brake pedal.**
- **The tightening torque for each portion is as follows:**

Unit: N·m (kgf-cm) [ft-lbf]

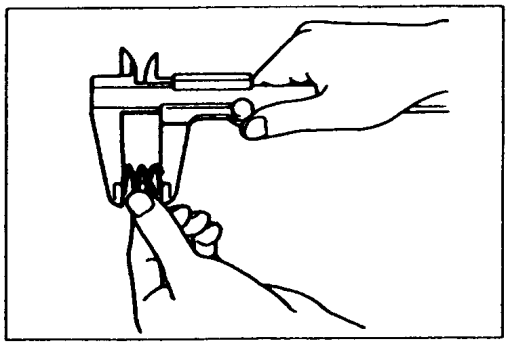
Brake drum set nut (hub bolt set nut)	FBMF16 :	68.65~88.26 (700~900) [50.65~65.12]
	FBMF20,25:	78.45~107.87 (800~1100) [57.86~79.56]
Backing plate self lock nut		117.68~137.29 (1200~1400) [86.82~101.29]
Wheel cylinder set bolt	FBMF16 :	7.85~11.77 (80~120) [5.79~8.68]
	FBMF20,25:	17.65~26.48 (180~270) [13.62~19.53]



Point Operations

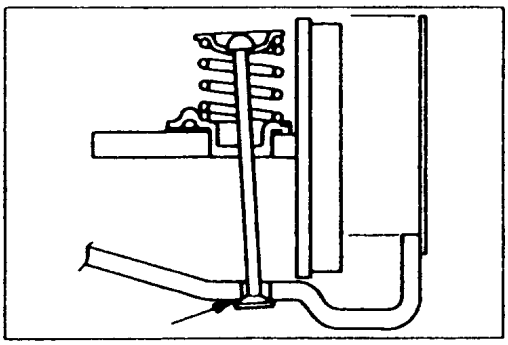
[Point 1]

Disassembly·Reassembly: SST 09510-31960-71



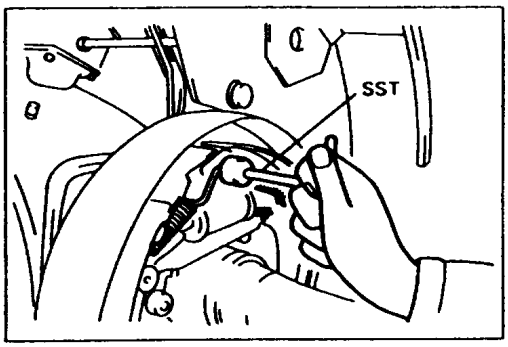
Inspection: Measure the free length of the hold down spring.

Standard free length:
FBMF16: 25.7 mm (1.012 in)
FBMF20,25: 35.7 mm (1.413 in)
Limit free length:
FBMF16: 23.0 mm (0.906 in)
FBMF20,25: 33.2 mm (1.307 in)

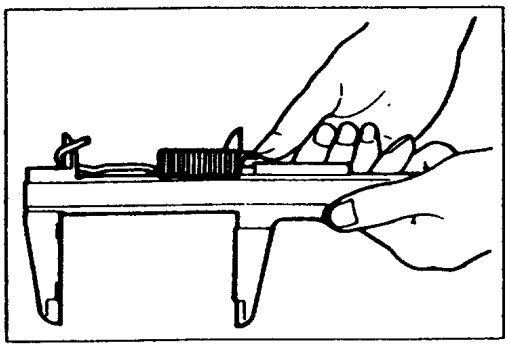


Reassembly: Coat sealant (08826-00080) on shoe hold down pin and the contact face on the rear side of the backing plate to eliminate any clearance.

[Point 2]

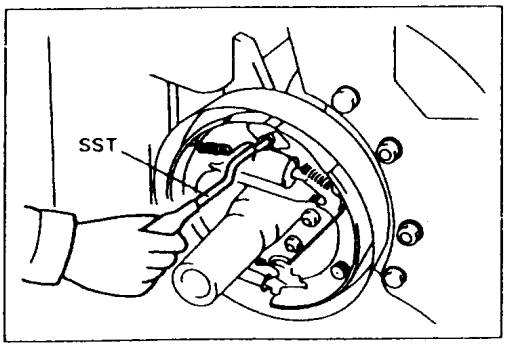


Disassembly: SST 09717-76001-71 (SST 09717-20010)

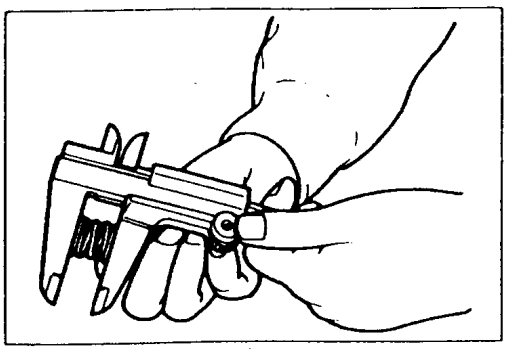


Inspection: Measure the free length of the anchor-to-shoe spring.

Standard free length:
FBMF16: 102 mm (4.02 in)
FBMF20,25: 106 mm (4.17 in)
Limit free length: Replace if there is any clearance in the coil.



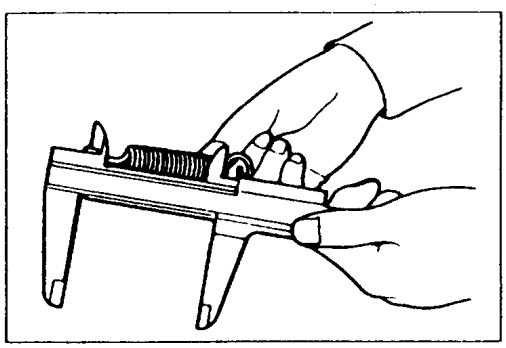
Reassembly: SST 09718-76001-71 (SST 09718-20010)



[Point 3]

Inspection: Measure the free length of the strut-to-shoe spring.

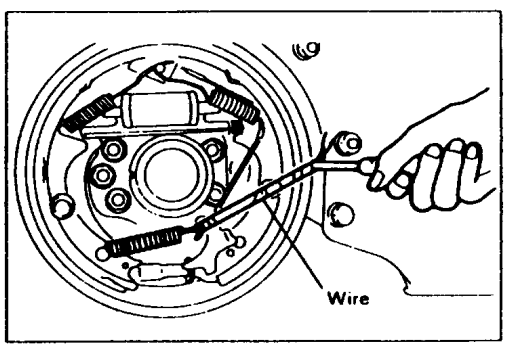
Standard free length:
FBMF16: 20.0 mm (0.787 in)
FBMF20,25: 29.8 mm (1.173 in)
Limit free length: Replace if there is any clearance in the coil.



[Point 4]

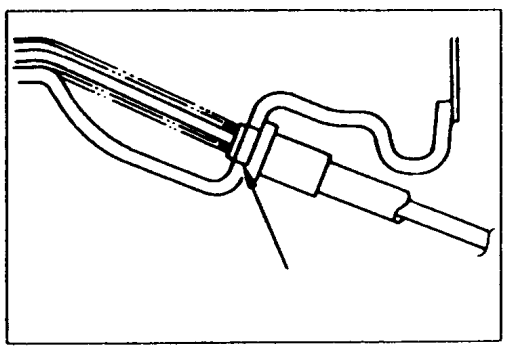
Inspection: Measure the free length of the adjuster spring.

Standard free length:
FBMF16: 79.0 mm (3.110 in)
FBMF20,25: 98.4 mm (3.874 in)
Limit free length: Replace if there is any clearance in the coil.



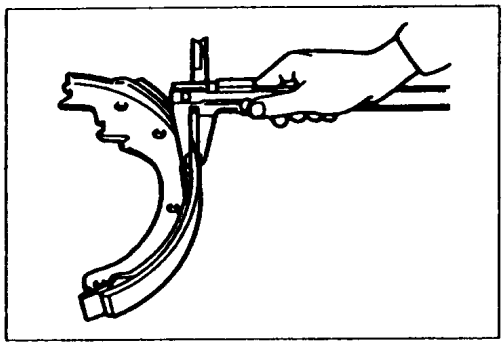
Reassembly: Apply grease on the threaded portion of the adjusting screw and in the cap.

Reassembly: Tie a wire at the end of the adjuster spring and set the spring by pulling it with a screw driver.



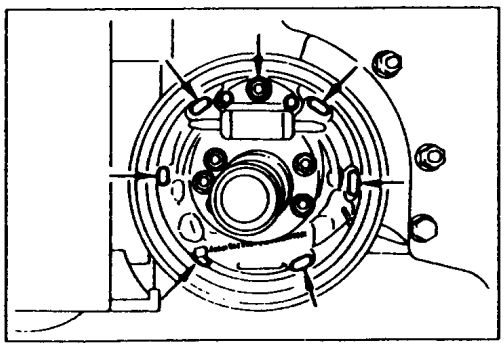
[Point 5]

Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the parking brake cable port of the backing plate to eliminate any clearance.

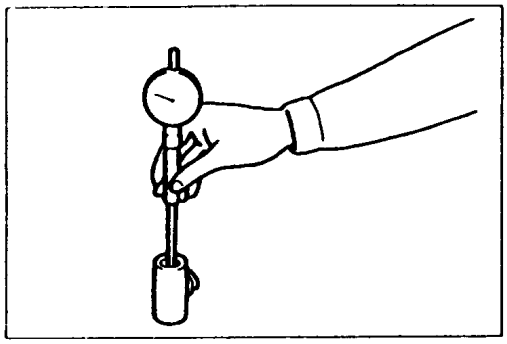


[Point 6]
Inspection: Measure the brake lining thickness.

Standard thickness:
FBMF16: 4.9 mm (0.193 in)
FBMF20,25: 5.1 mm (0.201 in)
Limit thickness: 1.0 mm (0.039 in)



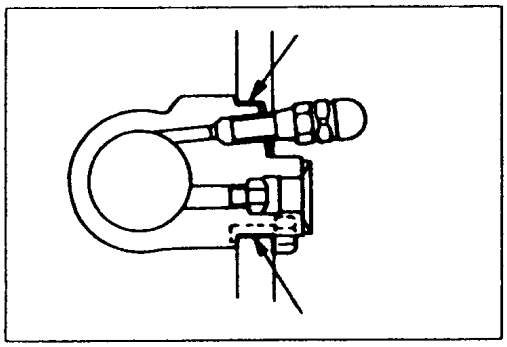
Reassembly: Coat grease on the illustrated portions (6 places in contact with the shoe rim and anchor pin) of the backing plate before installing the brake shoe.



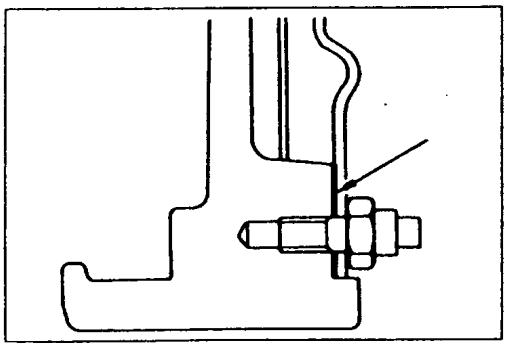
[Point 7]

Inspection: Measure the clearance between the wheel cylinder and piston.

Limit piston clearance: 0.125 mm (0.00492 in)

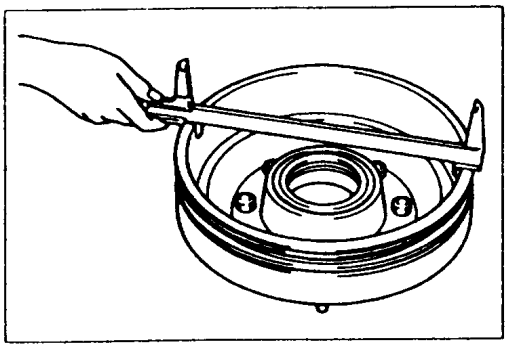


Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the wheel cylinder portion for fitting to the backing plate and whole circumference on the set bolt to eliminate any clearance.



[Point 8]

Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the joint face between the backing plate and front axle bracket to eliminate any clearance.

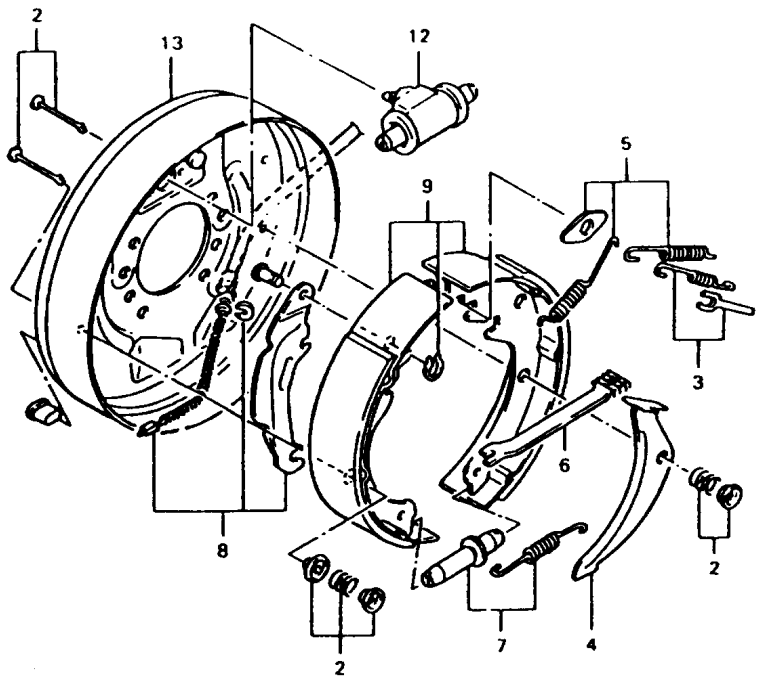


[Point 9]

Inspection: Measure the inside diameter of the brake drum.

Standard inside diameter:
FBMF16: 254.0 mm (10.000 in)
FBMF20,25: 279.4 mm (11.000 in)
Limit inside diameter:
FBMF16: 256.0 mm (10.079 in)
FBMF20,25: 281.4 mm (11.079 in)

DISASSEMBLY·INSPECTION·REASSEMBLY (FBMF30)



1 Front axle hub
10 Brake fluid
11 Brake pipe
14 Brake drum

Disassembly Procedure

1 Remove the front axle hub. (See the front axle shaft, hub removal section on page 9-7.)

2 Remove the hold down spring. **[Point 1]**

3 Remove the pawl lever stopper. **[Point 2]**

4 Remove the pawl lever.

5 Remove the anchor-to-shoe spring. **[Point 3]**

6 Remove the strut lever. **[Point 4]**

7 Remove the adjuster spring and adjusting screw. **[Point 5]**

8 Disconnect the parking brake cable. **[Point 6]**

9 Remove the brake shoe. **[Point 7]**

10 Drain brake fluid.

11 Disconnect the brake pipe.

12 Remove the wheel cylinder ASSY. **[Point 8]**

13 Remove the backing plate. **[Point 9]**

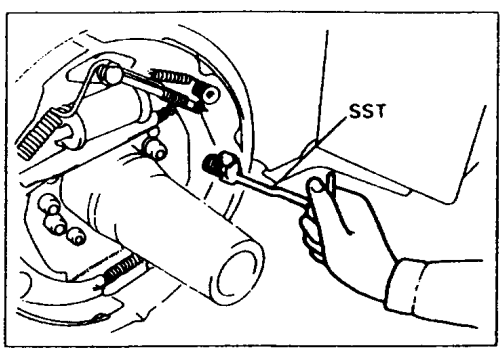
14 Disconnect the brake drum from the hub. **[Point 10]**
(See the front axle shaft, hub removal section on page 9-7.)

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.
In the reassembly procedure, however, reverse the order of steps 2 and 3 in disassembly procedure. (Install the pawl lever stopper after installing the hold spring.)

Note:
- **Refer to the note for the front axle shaft, hub installation procedure (on page 9-8).**
- **Check no grease or oil adhesion on the brake lining and brake drum interior surface before reassembly.**
- **Set the installed brake shoe outside diameter to the following dimension by tightening the adjusting screw before installing the hub W/brake drum. (Set it to approx. 1 mm (0.04 in) smaller than the brake drum inside diameter.)**
  Installed brake shoe outside diameter: 309 mm (12.17 in)
- **Coat thread tightener 08833-76001-71 (08833-00070) on the brake drum set nut before tightening. (Applicable when the hub and brake drum are disconnected.)**
- **Drain air from the brake system after reassembly.**
- **After reassembly, adjust the brake performance. For adjustment repeat vehicle forward travel and reverse travel and stop the vehicle by depressing the brake pedal each time.**
- **The tightening torque for each portion is as follows:**

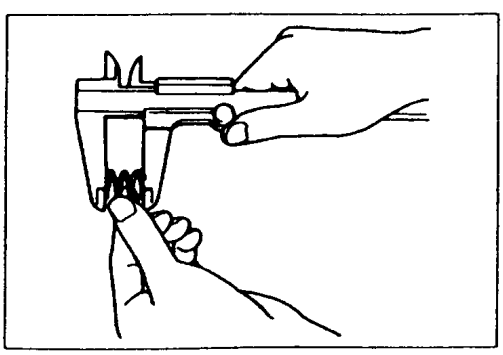
Brake drum set nut (hub bolt set nut)	:	166.71 ~ 205.94 N·m (1700 ~ 2100 kgf-dm) [123.00 ~ 151.94 ft-lbf]
Backing plate self lock nut	:	117.68 ~ 137.29 N·m (1200 ~ 1400 kgf-dm) [86.82 ~ 101.29 ft-lbf]
Wheel cylinder set bolt	:	14.71 ~ 19.61 N·m (150 ~ 200 kgf-dm) [10.85 ~ 14.47 ft-lbf]



Point Operations

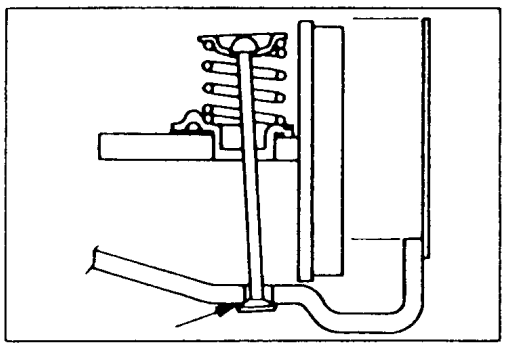
[Point 1]

Disassembly·Reassembly: SST 09510-31960-71

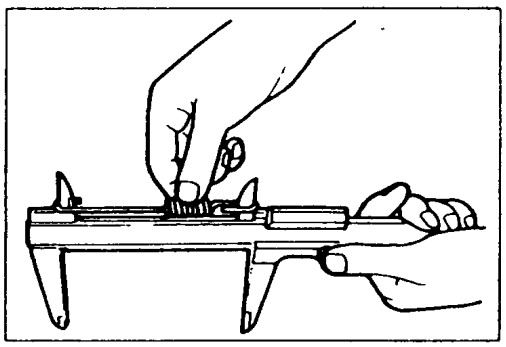


Inspection: Measure the free length of the hold down spring.

Standard free length: 31.3 mm (1.232 in)
Limit free length: 28.2 mm (1.110 in)



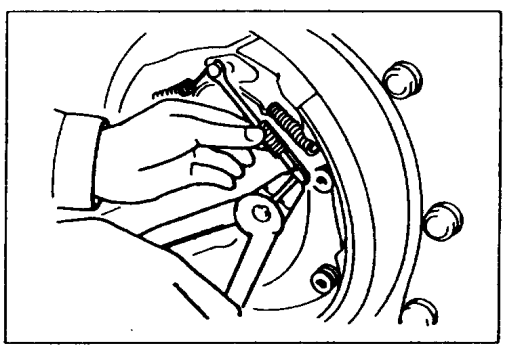
Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the shoe hold down pin contact portion the rear side of the backing plate to eliminate any clearance.



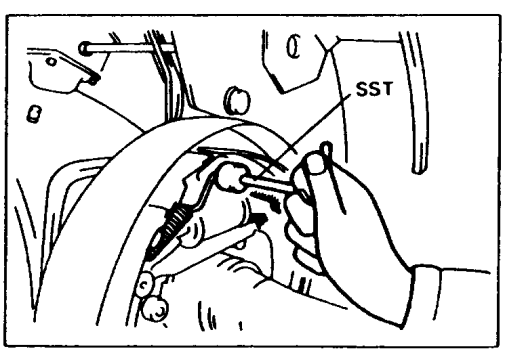
[Point 2]

Inspection: Measure the free length of the actuator spring.

Standard free length: 124.5 mm (4.902 in)
Limit free length: Replace if there is any clearance in the coil.

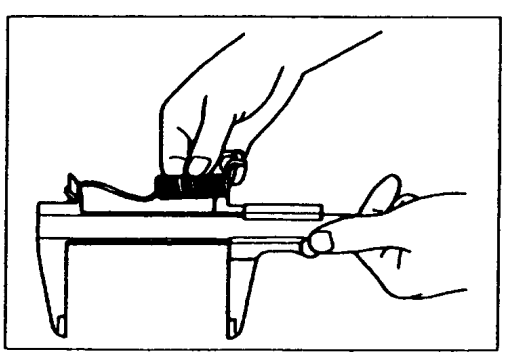


Reassembly: Use snap ring pliers and install the pawl lever stopper and actuator spring.



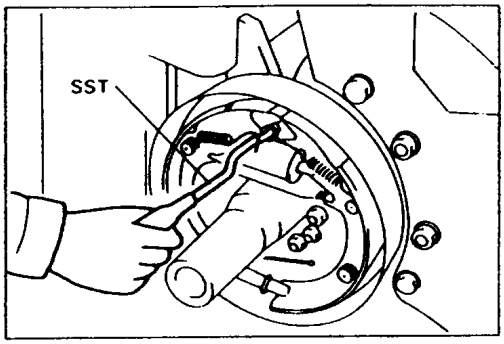
[Point 3]

Disassembly: SST 09717-76001-71 (SST 09717-20010)

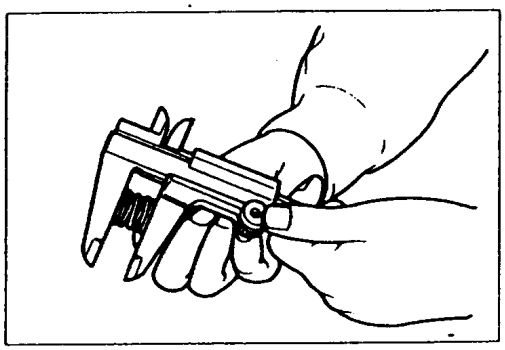


Inspection: Measure the free length of the anchor-to-shoe spring.

Standard free length: 106 mm (4.17 in)
Limit free length: Replace if there is any clearance in the coil.



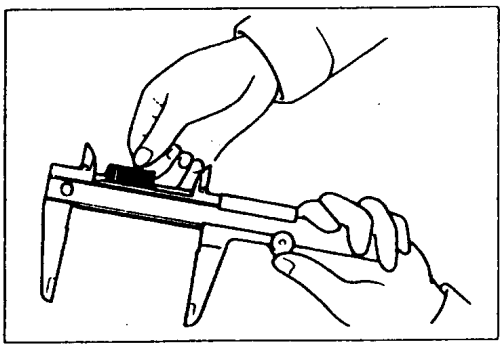
Reassembly: SST 09718-76001-71 (SST 09718-20010)



[Point 4]

Inspection: Measure the free length of the strut-to-shoe spring.

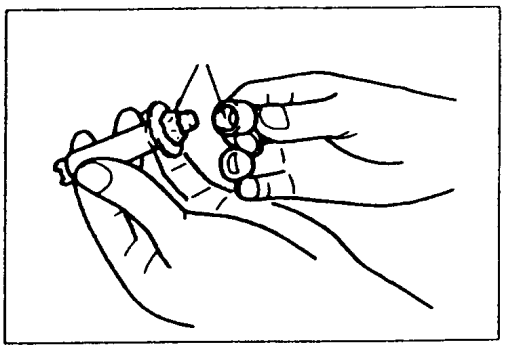
Standard free length: 23.0 mm (0.906 in)
Limit free length: 20.0 mm (0.784 in)



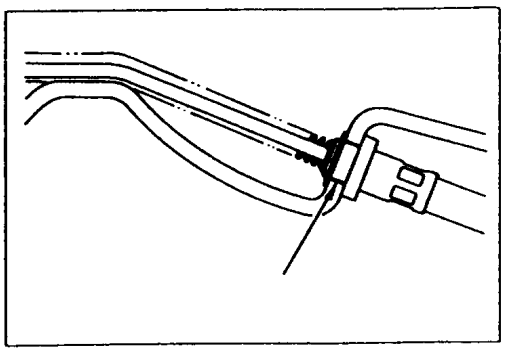
[Point 5]

Inspection: Measure the free length of the adjuster spring.

Standard free length: 86.0 mm (3.386 in)
Limit free length: Replace if there is any clearance in the coil.

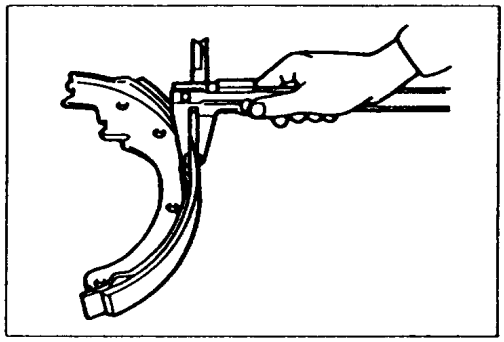


Reassembly: Apply grease to the threaded portion of the adjusting spring and in the cap.



[Point 6]

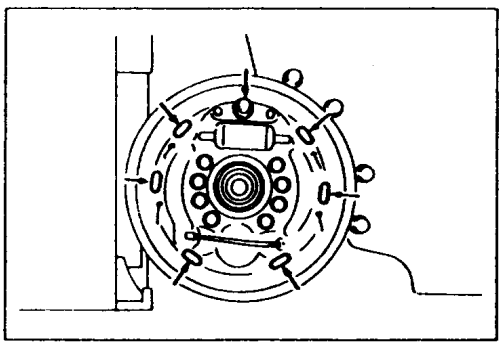
Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the parking brake cable outlet in the backing plate to eliminate any clearance.



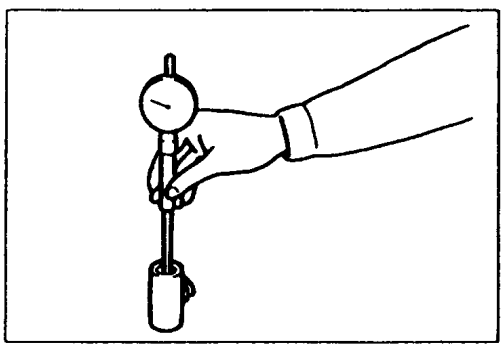
[Point 7]

Inspection: Measure the brake lining thickness.

Standard thickness: 7.0 mm (0.276 in)
Limit thickness: 2.0 mm (0.079 in)



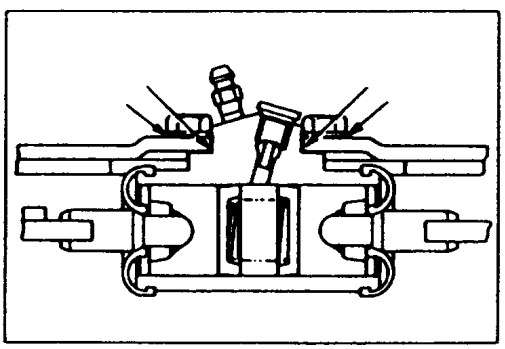
Reassembly: Before installing the brake shoe, coat grease on the illustrated portions (6 places in contact with the shoe rim and anchor pin) of the backing plate.



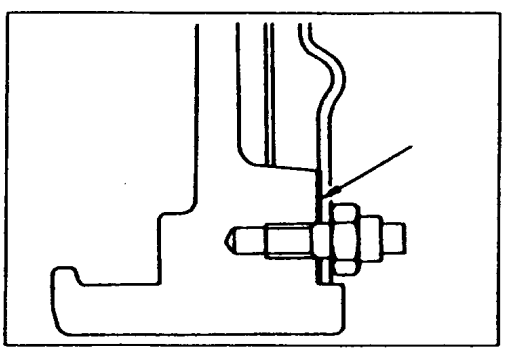
[Point 8]

Inspection: Measure the clearance between the wheel cylinder and piston:

Limit piston clearance: 0.145 mm (0.00571 in)

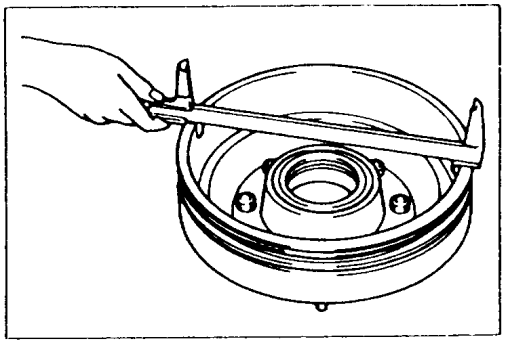


Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the wheel cylinder portion for fitting in the backing plate and whole circumference of the set bolt to eliminate any clearance.



[Point 9]

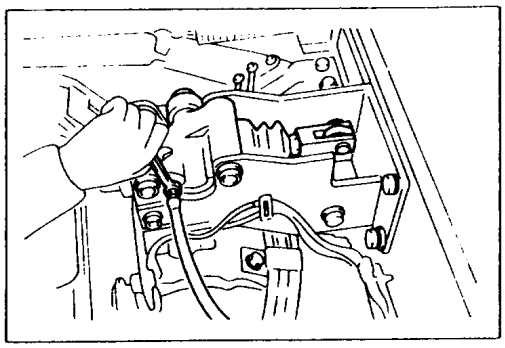
Reassembly: Coat sealant 08826-76001-71 (08826-00080) on the joint face of the backing plate with the front axle bracket to eliminate any clearance.



[Point 10]

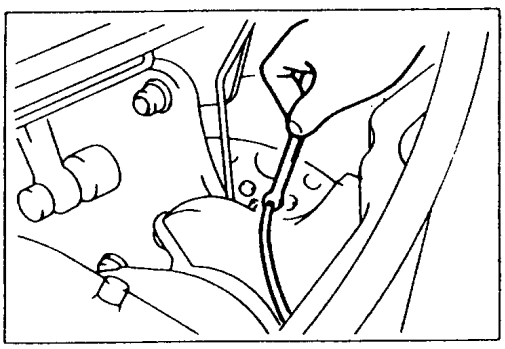
Inspection: Measure the brake drum inside diameter

Standard inside diameter: 310 mm (12.20 in)
Limit inside diameter: 312 mm (12.28 in)



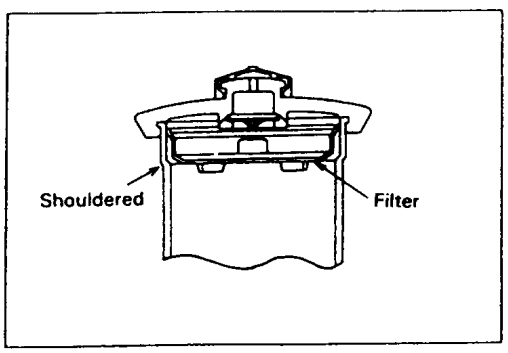
AIR BLEEDING FROM BRAKE SYSTEM

Note:
Carry out air bleeding operation while adding brake fluid to the reservoir tank to prevent it from becoming insufficient.



1. Bleed air from the brake master cylinder.
   (1) Depress the brake pedal several times to compress the air in the piping and maintain that state.
   (2) Loosen the breather plug to bleed air in the piping with the brake fluid and tighten the plug immediatelv before the brake fluid discharge stops.
   (3) Repeat steps (1) and (2) above until no air bubble is seen in the flowing out brake fluid.

2. Bleed air from wheel cylinders RH and LH.
   (1) Perform the same operation as above for each of the wheel cylinders RH and LH at a time.



3. Add brake fluid to the specified level.
   (1) For addition, pour brake fluid through the filter provided at the reservoir tank.
   (2) Add brake fluid to the shouldered portion in the reservoir tank.

BRAKING FORCE INSPECTION·ADJUSTMENT

1. Inspect the braking force by using a brake tester or by the brake test.

   Braking distance (no-load state)

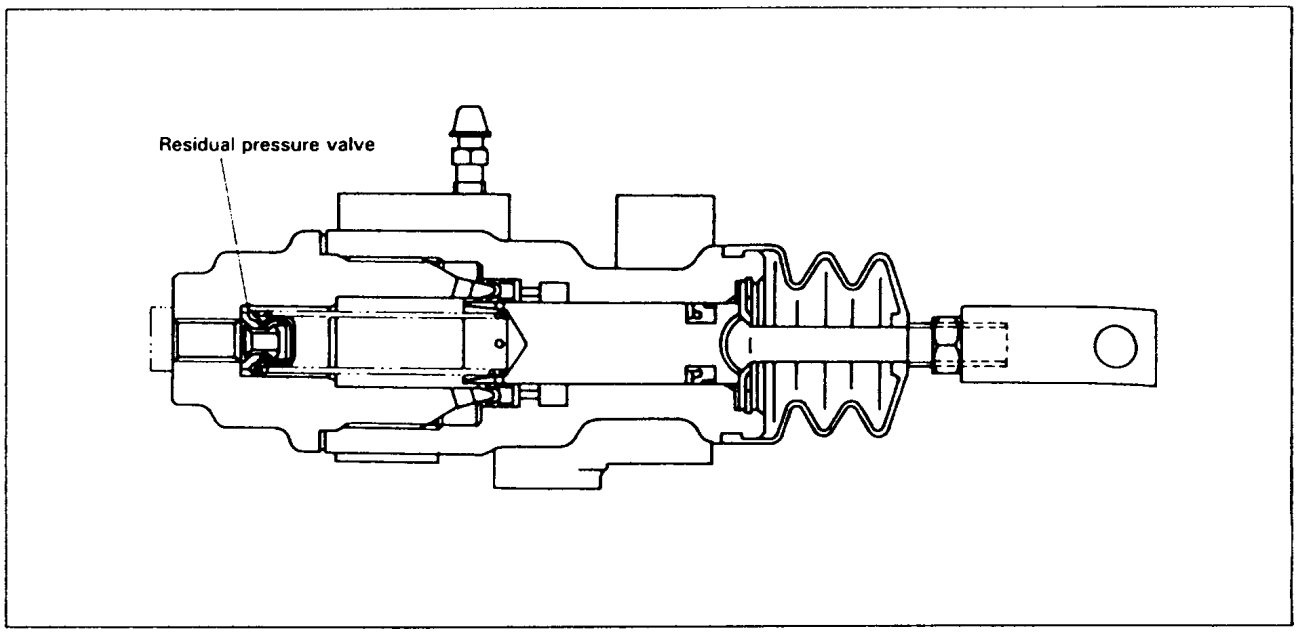
	FBMF16	FBMF20,25	FBMF30
Initial speed of braking km/h (mph)	16.0 (9.942)	17.0 (10.563)	15.0 (9.321)
Stopping distance m (ft)	5.0 (16.4) or less	←	←

2. Adjust the braking force.

   (1) Repeat forward travel and reverse travel, and adjust the brake shoe clearance.
   The adjusting screw automatically adjust the brake shoe clearance when the brake pedal is depressed at the time of reverse traveling.
   (2) When the braking force is insufficient, remove the brake drum and perform inspection as adjuster malfunction, lining contact defect, foreign matter adhesion on lining surface, brake fluid leakage or other defect is suspected.
   (3) When the brake shoe is replaced with a new one, repeat forward travel and reverse travel for running in.

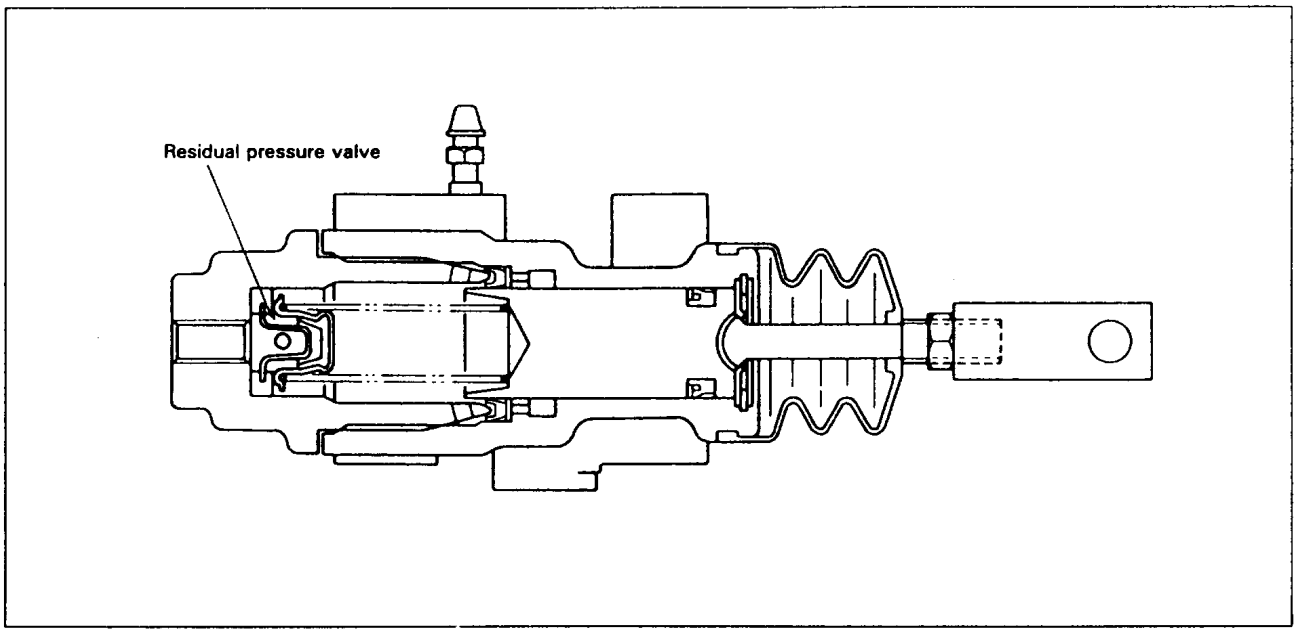
MASTER CYLINDER

FBMF16,20,25



Master Cylinder Sectional View (1 ~ 2 ton Series) BARS46

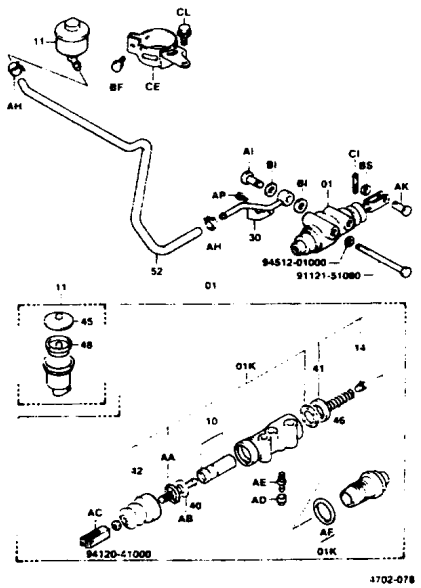
FBMF30



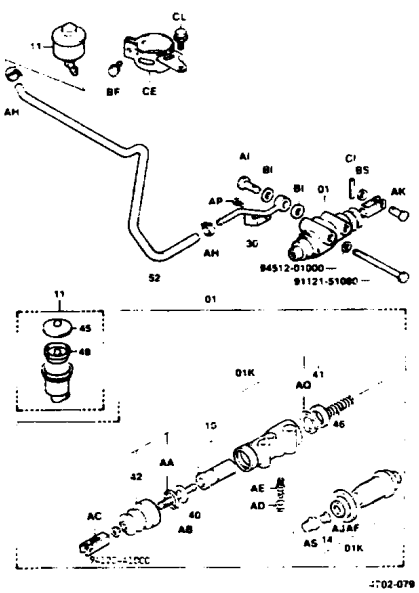
Master Cylinder Sectional View (3 ton Series) BARS156

COMPONENTS

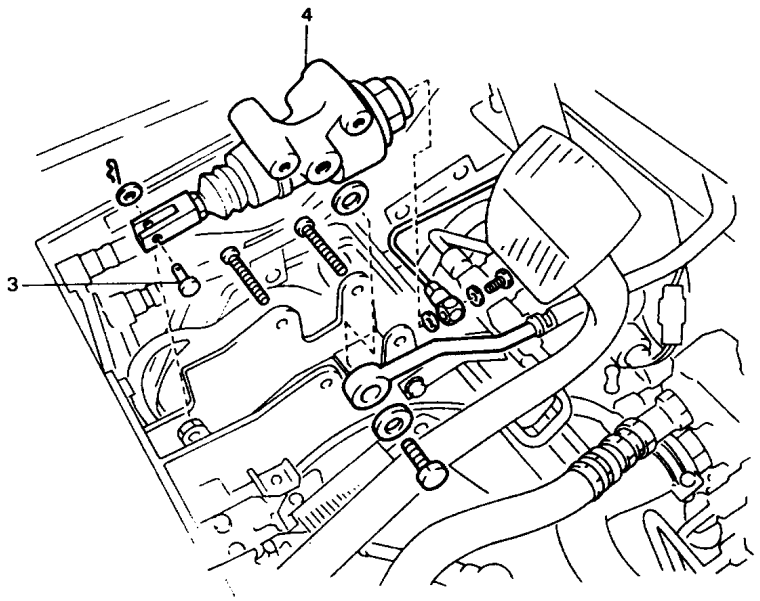
FBMF16,20,25



FBMF30



REMOVAL·INSTALLATION



1 Instrument panel LH
2 Brake fluid

Removal Procedure

1 Remove the instrument panel LH and toe board.

2 After draining the brake fluid, disconnect the piping.

3 Remove the push rod clevis pin.

4 Remove the brake master cylinder.

Installation Procedure

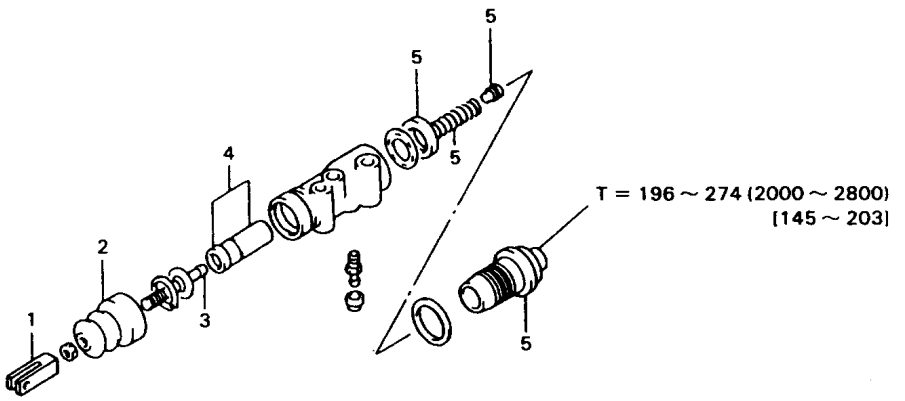
The installation procedure is the reverse of the removal procedure.

Note:
- **See the brake pedal adjustment procedure (on page 12-33) for adjustment after installation.**
- **Carry out air bleeding (on page 12-20).**

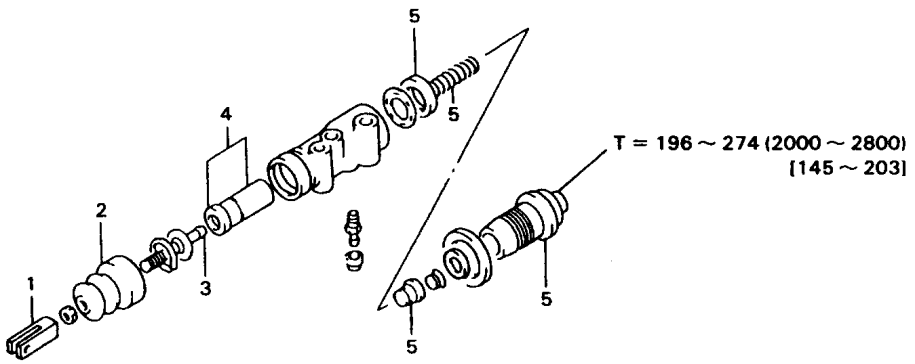
DISASSEMBLY·INSPECTION·REASSEMBLY

T = N·m (kgf-cm) [ft-lbf]

FBMF16,20,25



FBMF30



Disassembly Procedure

1 Loosen the lock nut and remove the clevis.

2 Remove the lock nut and boot.

3 Remove the push rod. **[Point 1]**

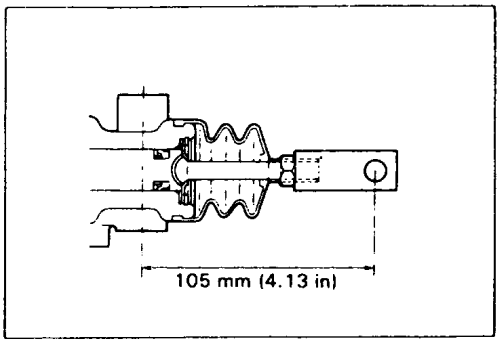
4 Remove the piston.

5 Remove the end cap, valve, spring and cylinder cup.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
Coat rubber grease on the piston cup before reassembly.



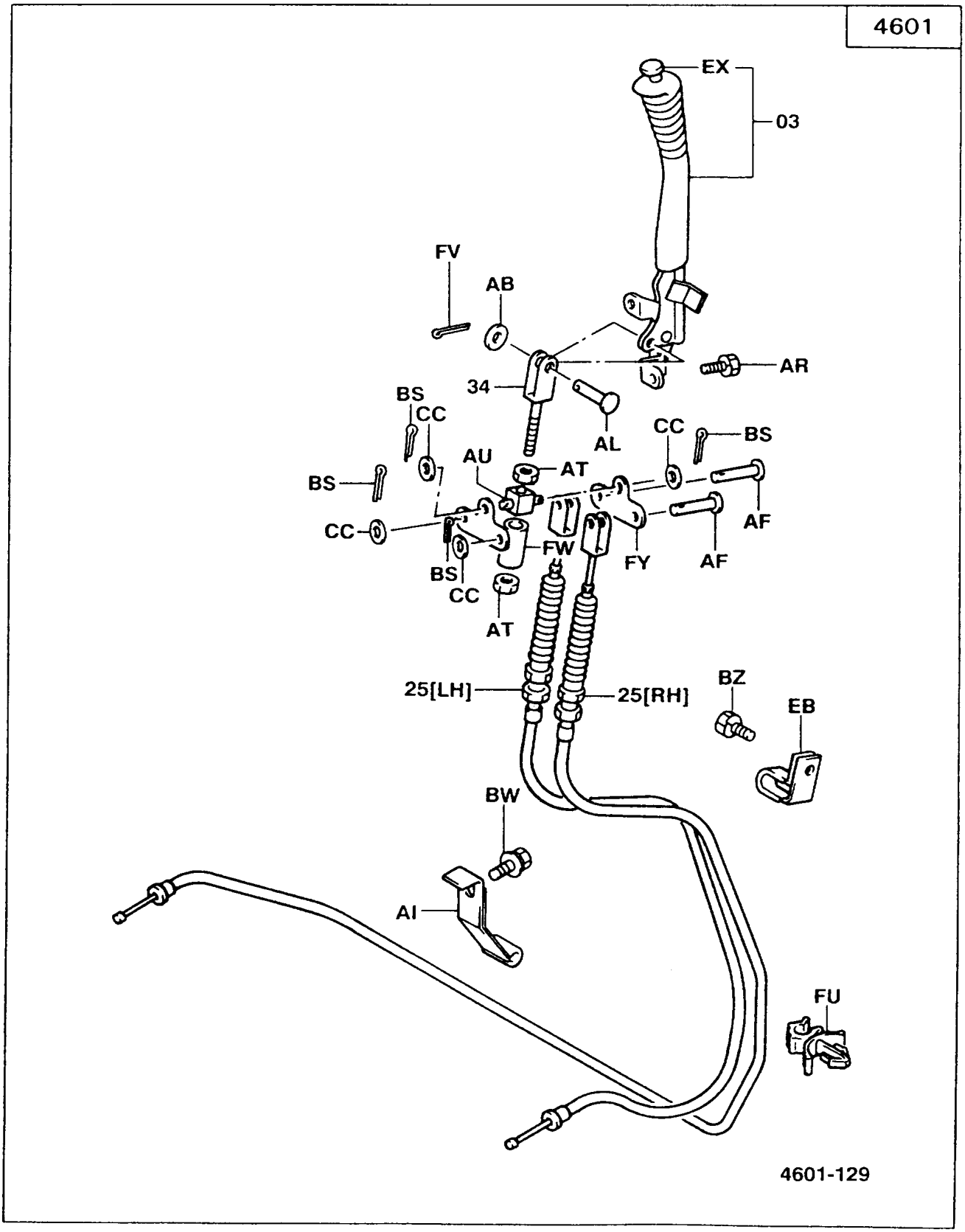
Point Operation

[Point 1]

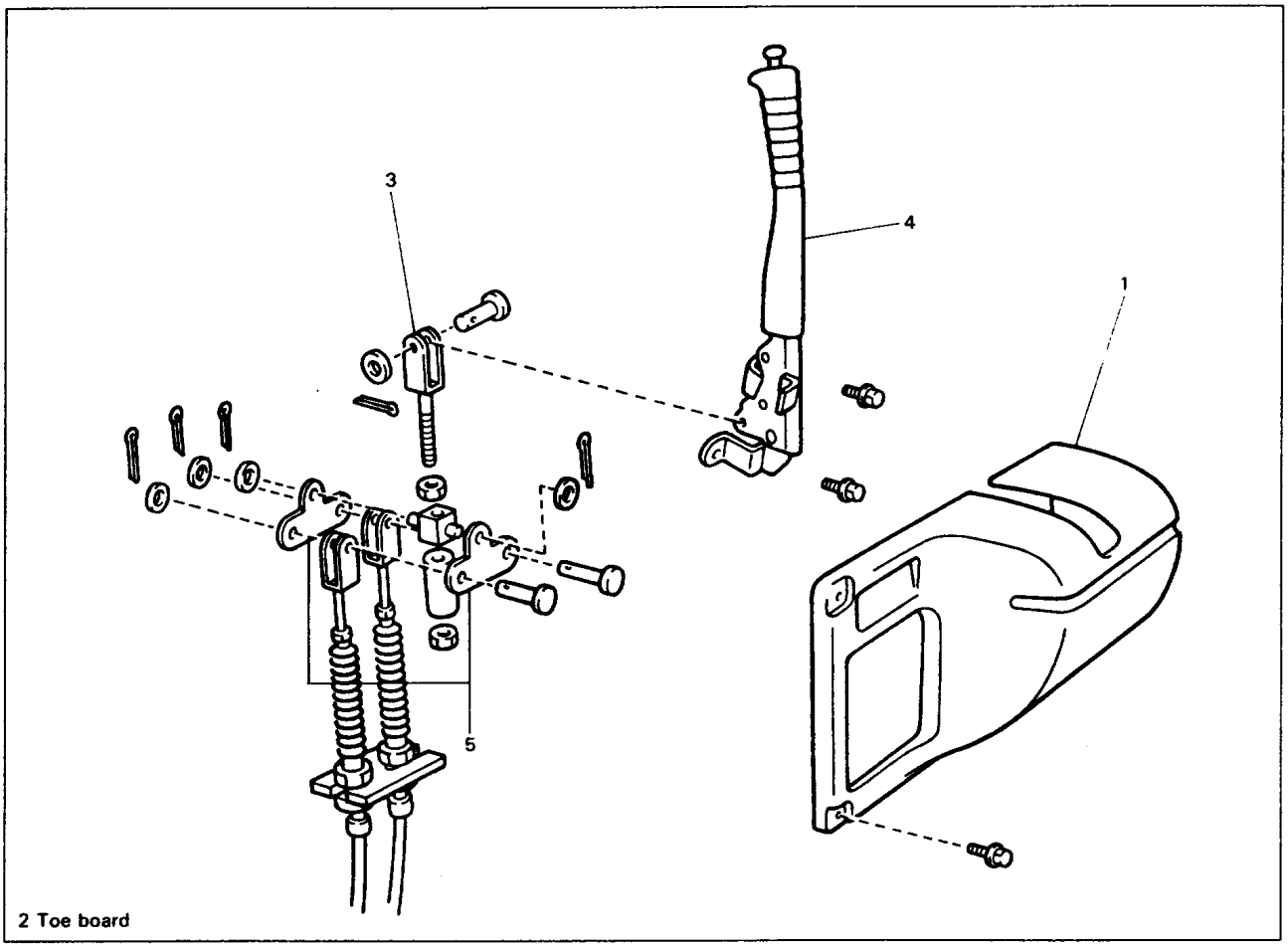
Installation: Temporarily set the push rod length to the illustrated dimension and make readjustment after installation.

PARKING BRAKE

COMPONENTS



REMOVAL·INSTALLATION



Removal Procedure

1 Remove the instrument panel LH.

2 Remove the toe board.

3 Disconnect the pull rod No.1.

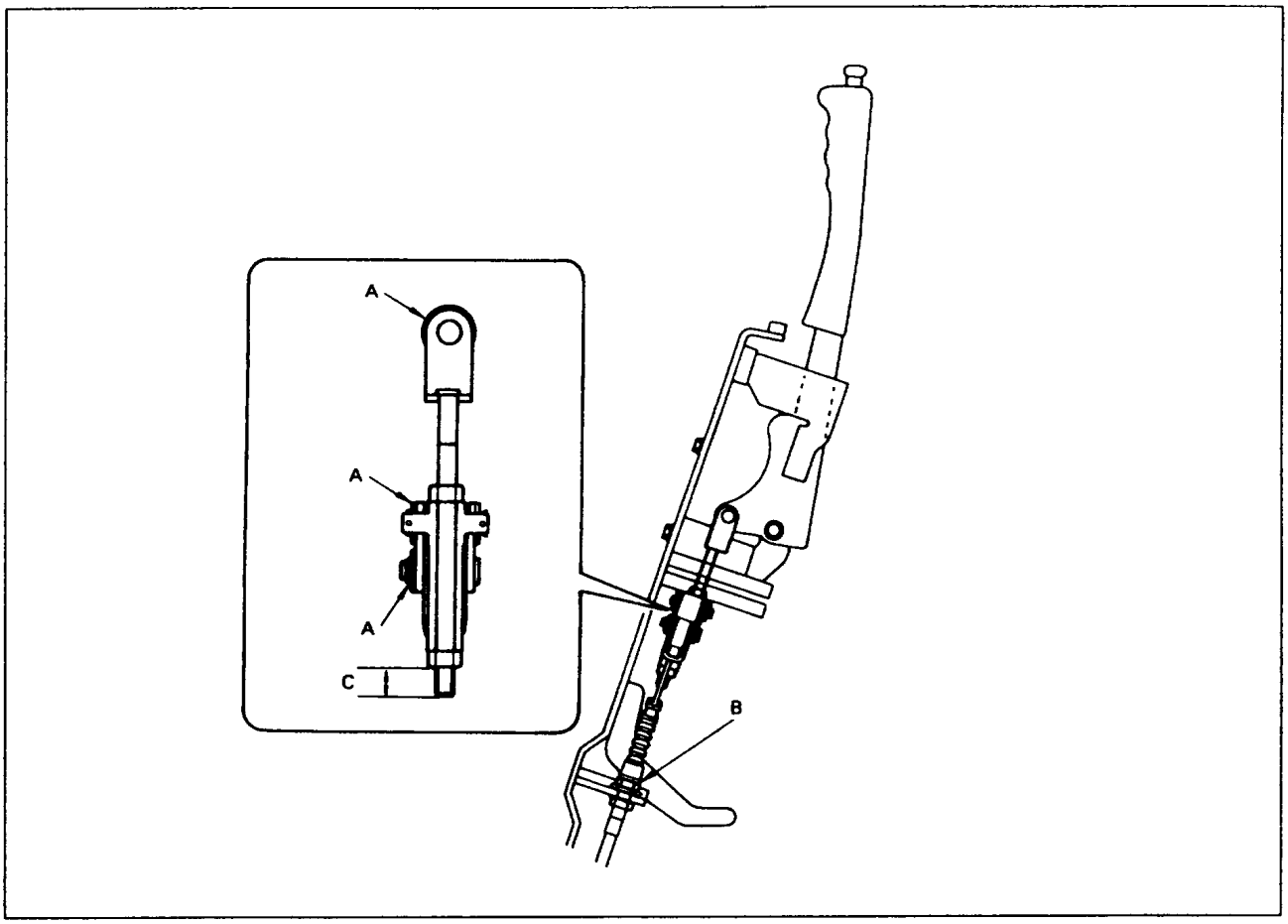
4 Remove the parking lever ASSY.

5 Remove the equalizer from the cables.

Installation Procedure

The installation procedure is the reverse of the remove procedure.

KEY POINTS IN SERVICE JOBS

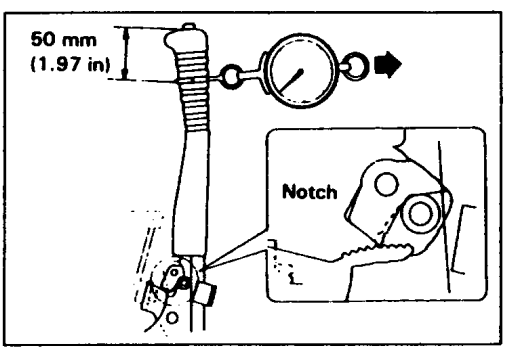


1 Coat grease on the link pin and moving surface (A).

2 Tighten lock nut (B) to a torque of 0.147 to 0.216 N·m (1.5 to 2.2 kgf-cm) [0.109 to 0.159 ft-lbf].

3 Set length (C) to 14 to 15 mm (0.55 to 0.59 in).

ADJUSTMENT

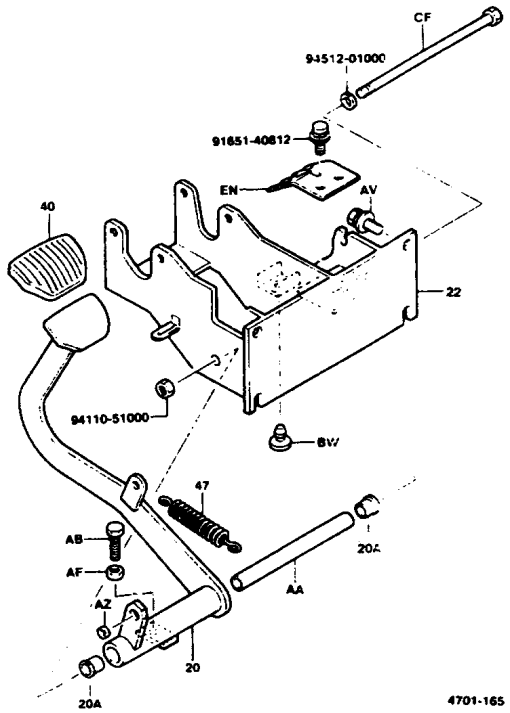


1 Adjust the rod length so that the pawl engages with the 3rd or 4th notch on the sector when the parking lever operating force at the illustrated position is 147 N (15 kgf) [33 lbf].

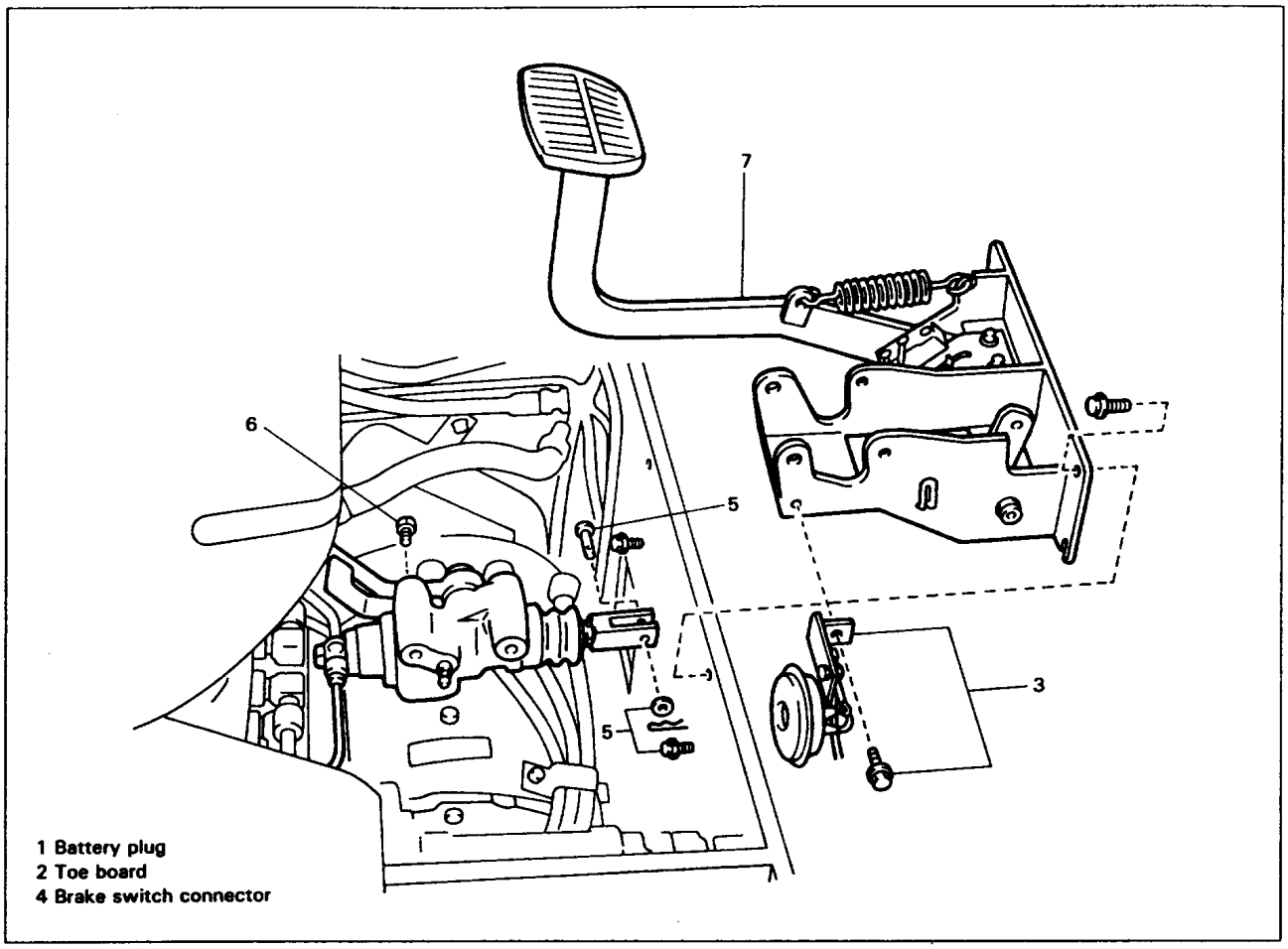
BRAKE PEDAL·BRACKET

COMPONENTS

4701



REMOVAL·INSTALLATION



Removal Procedure

1 Disconnect the battery plug.

2 Remove the toe board.

3 Remove the horn with bracket and brake pipe clamp bolt.

4 Disconnect the brake switch connector.

5 Remove the push rod clevis pin.

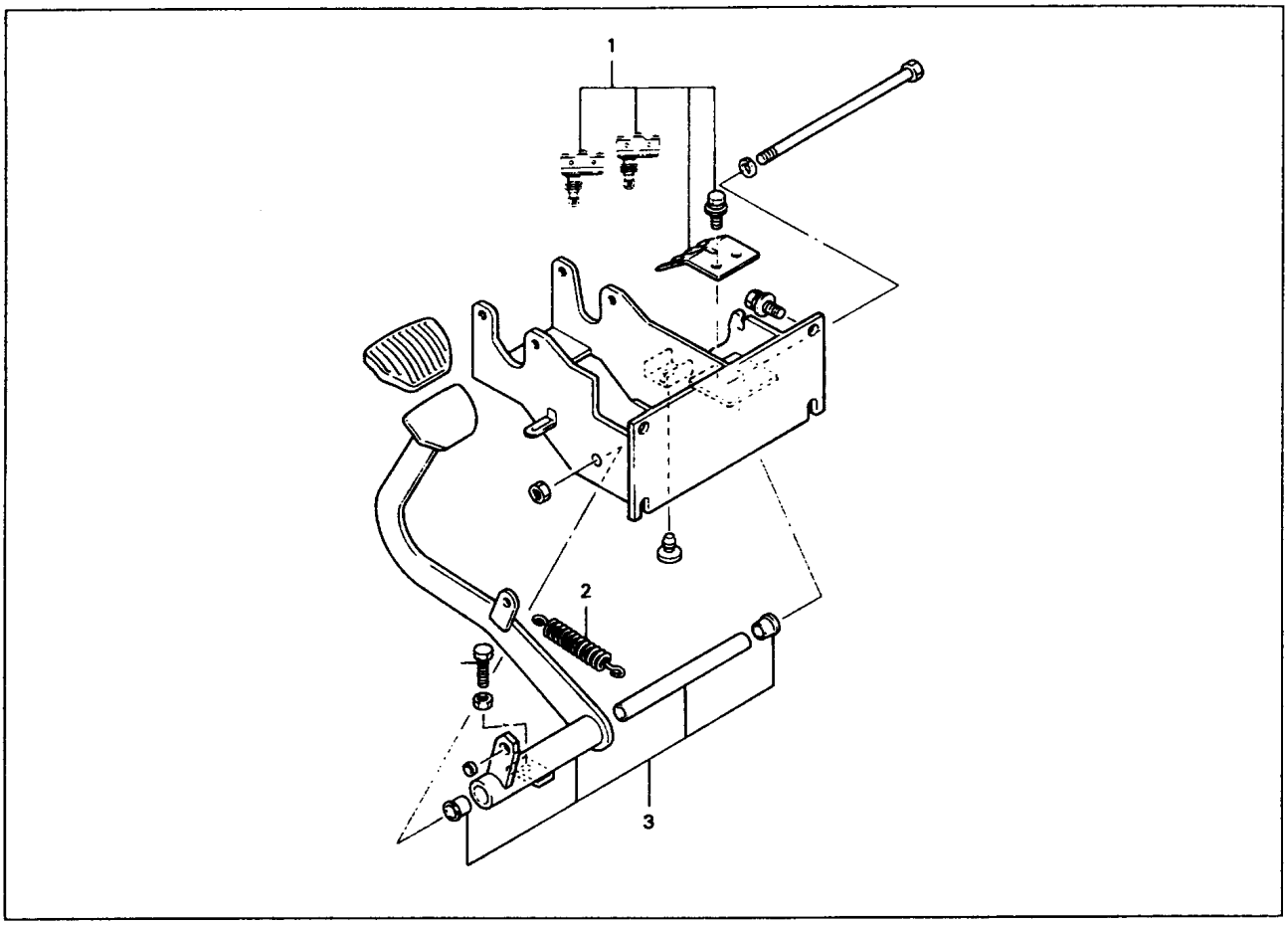
6 Remove the 2 master cylinder set bolts.

7 Remove two bolts on the upper side and loosen the lower bolts to remove the pedal bracket and brake pedal.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

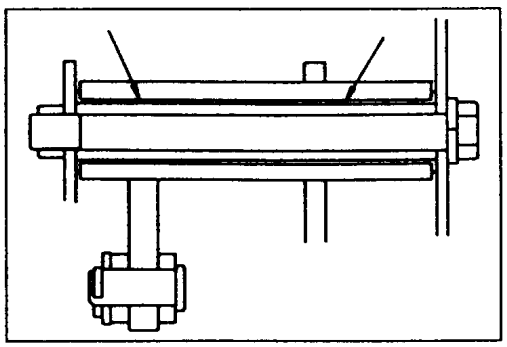
1 Remove the brake switch W/ bracket.

2 Remove the return spring.

3 Remove the brake pedal and bushings. [Point 1]

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.



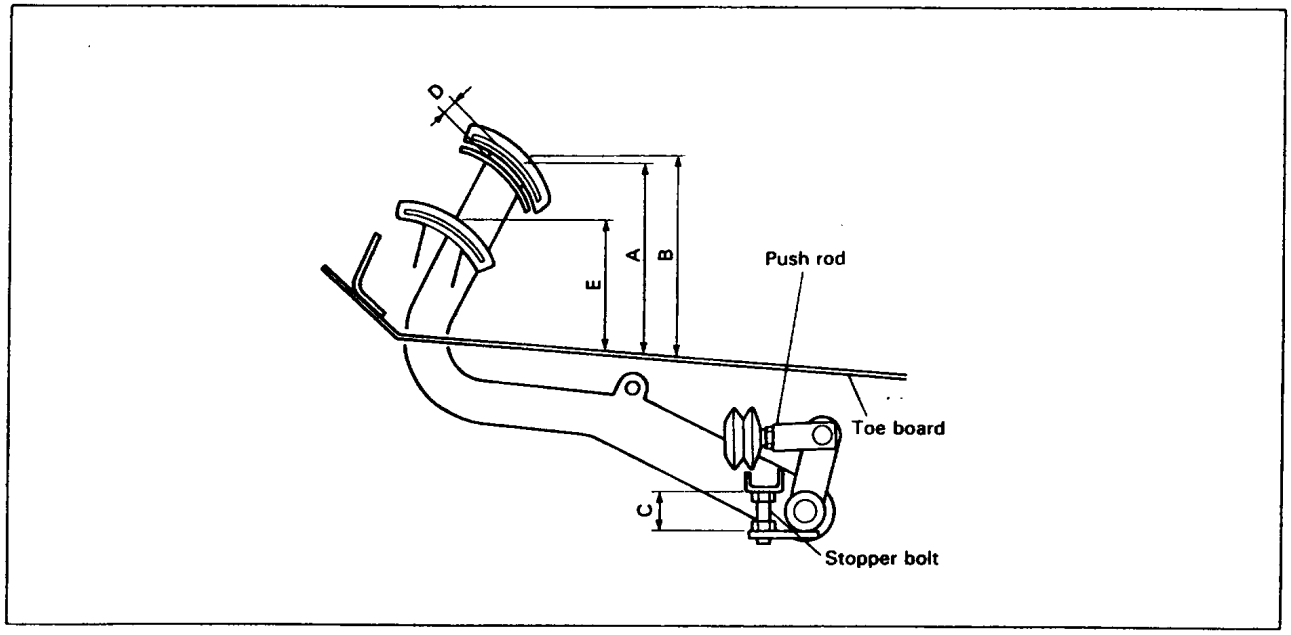
Point Operation

[Point 1]

Reassembly: Coat grease on the bushing surface (A).

ADJUSTMENT

Brake Pedal Adjustment



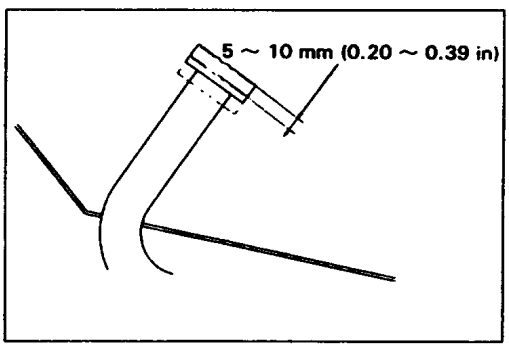
1. Adjust the brake pedal height and play.

   (1) Adjust the stopper bolt length (dimension C) to make the brake pedal height (dimension A or B) satisfy the standard below.
   (2) Adjust the push rod length to make the brake pedal play (dimension D) satisfy the standard below.
   (3) After adjustment, check the depressed height (dimension E).

Unit: mm (in)

A	B	C (Reference)	D	E
130 ~ 135 (5.12 ~ 5.31)	134 ~ 139 (5.28 ~ 5.47)	26 (1.02)	3 ~ 7 (0.12 ~ 0.28)	60 (2.36) or more

A: Dimension without pad
B: Dimension with pad
C: Reference value
D: Pedal play corresponding to push rod play (G)
E: Depressed height (with pad)



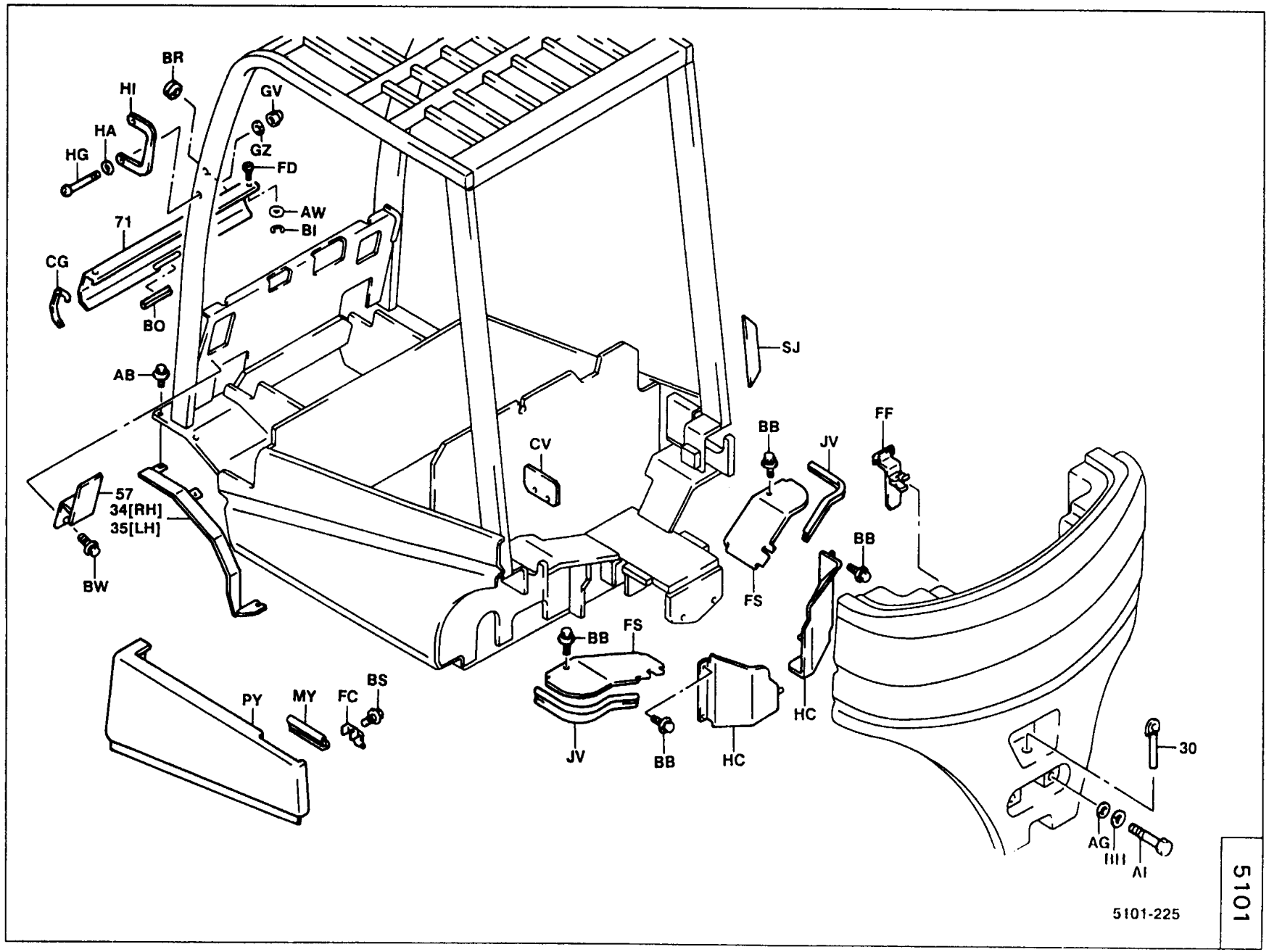
Brake Switch Adjustment

Standard

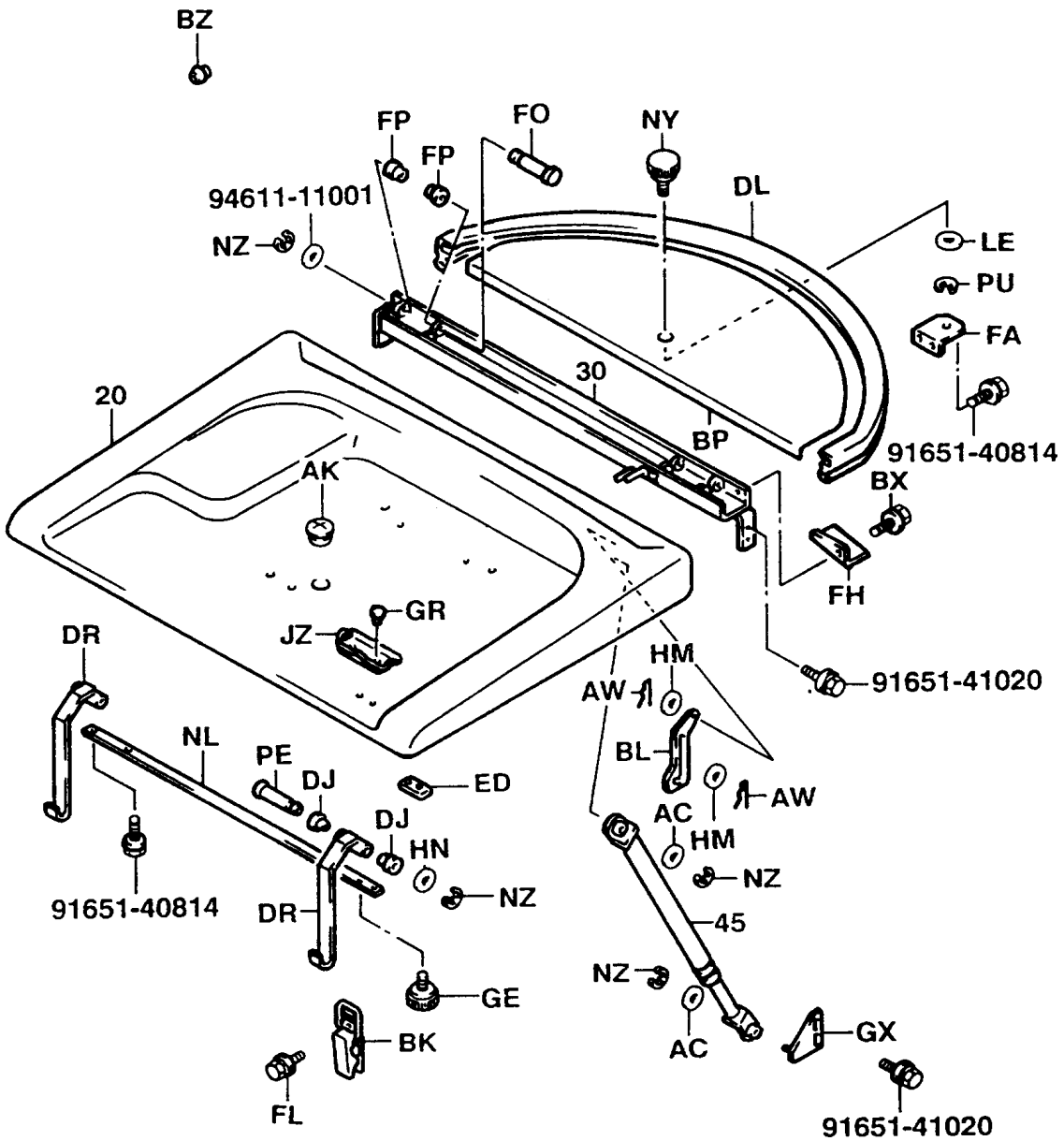
RH side (for stop lamp):

The switch is turned ON at 5 to 10 mm (0.20 to 0.39 in) (dimension A in the figure) in the brake pedal play range.

BODY

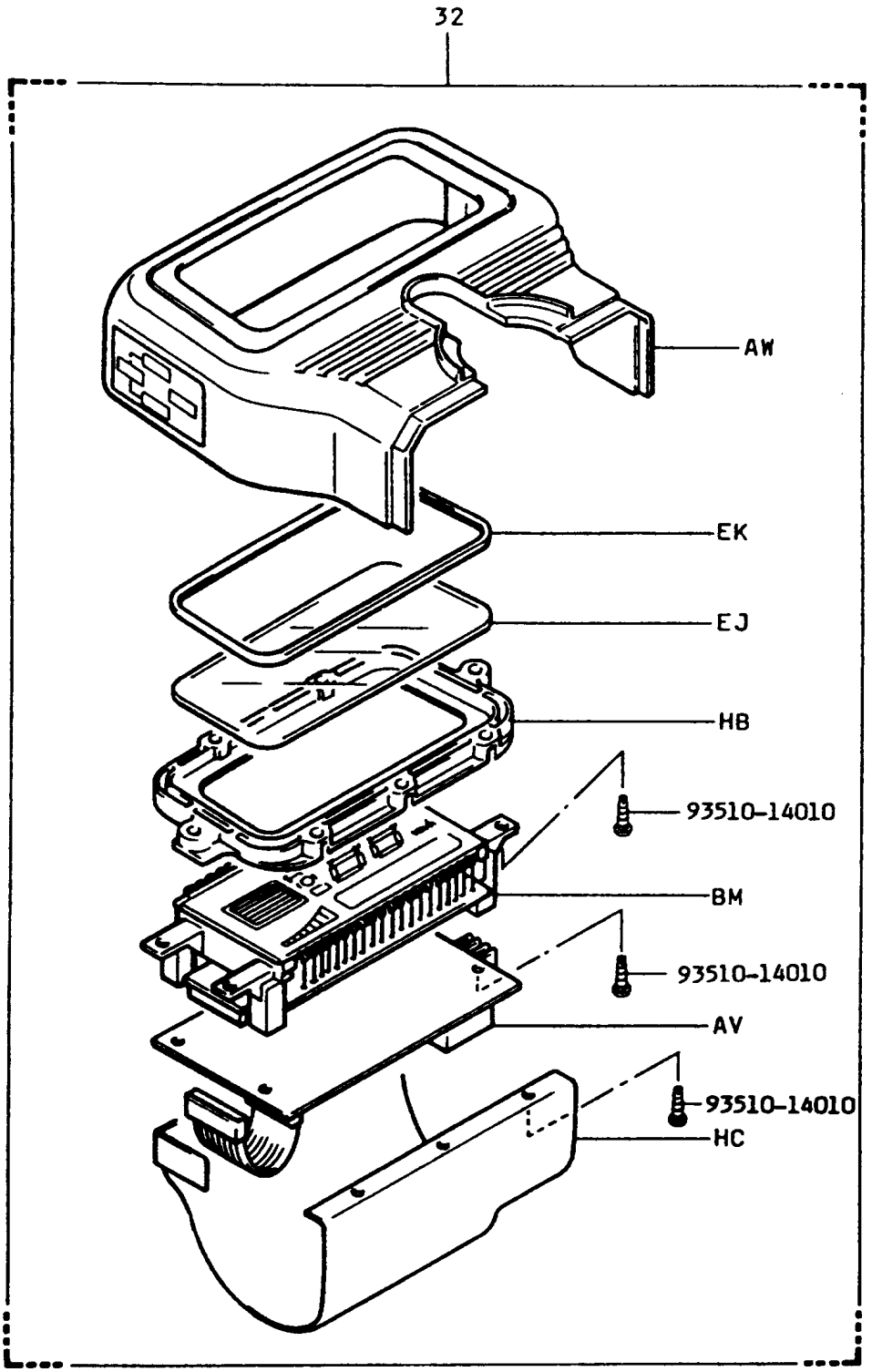


5201



5201-168

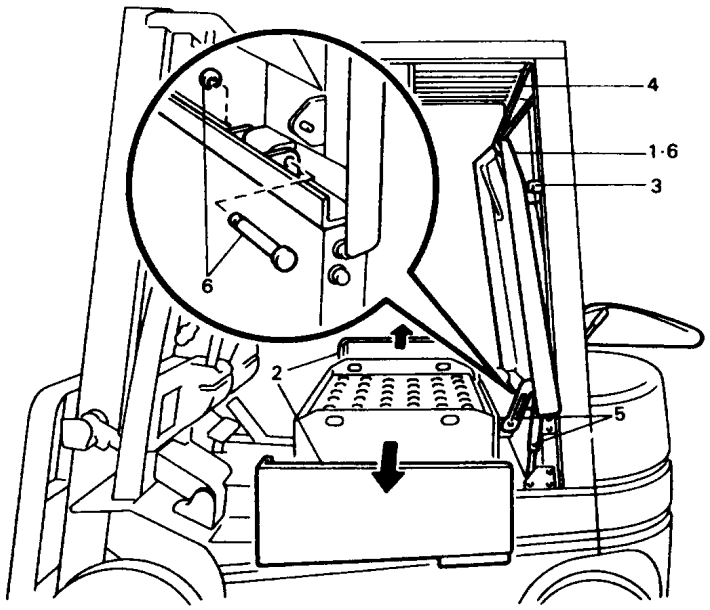
5702



5702-068A

BATTERY HOOD

REMOVAL·INSTALLATION



Removal Procedure

1 Release the tilt lock and open the battery hood.

2 Remove the side frame covers.

3 Remove the cushions.

4 Support the battery hood securely with a rope.

5 Remove the battery hood damper and battery hood stay.

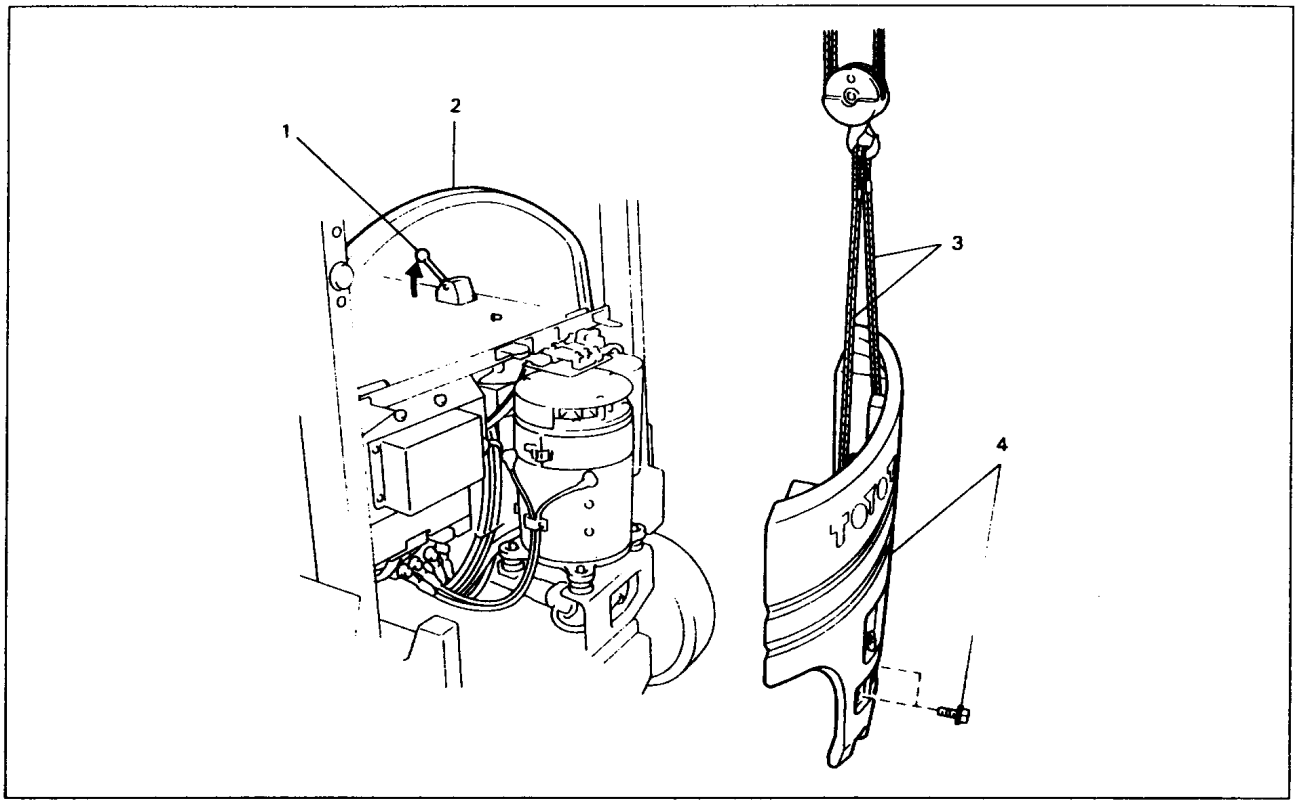
6 Remove the pins and battery hood.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

COUNTER WEIGHT

REMOVAL·INSTALLATION



Removal Procedure

1 Disconnect the battery plug.

2 Open the rear hood.

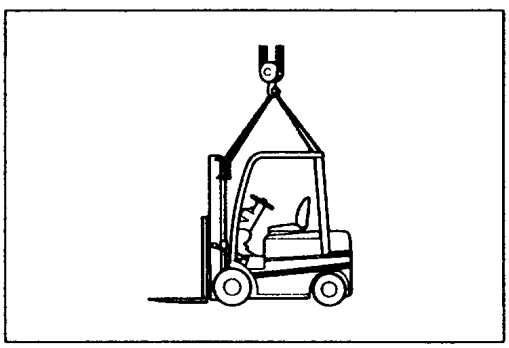
3 Hook wire ropes in the counterweight.

Caution: Use wire ropes having sufficient strength. (See page 0-15)

4 Remove the counterweight set bolts and counterweight.

Installation Procedure

The installation procedure is the reverse of the removal procedure.



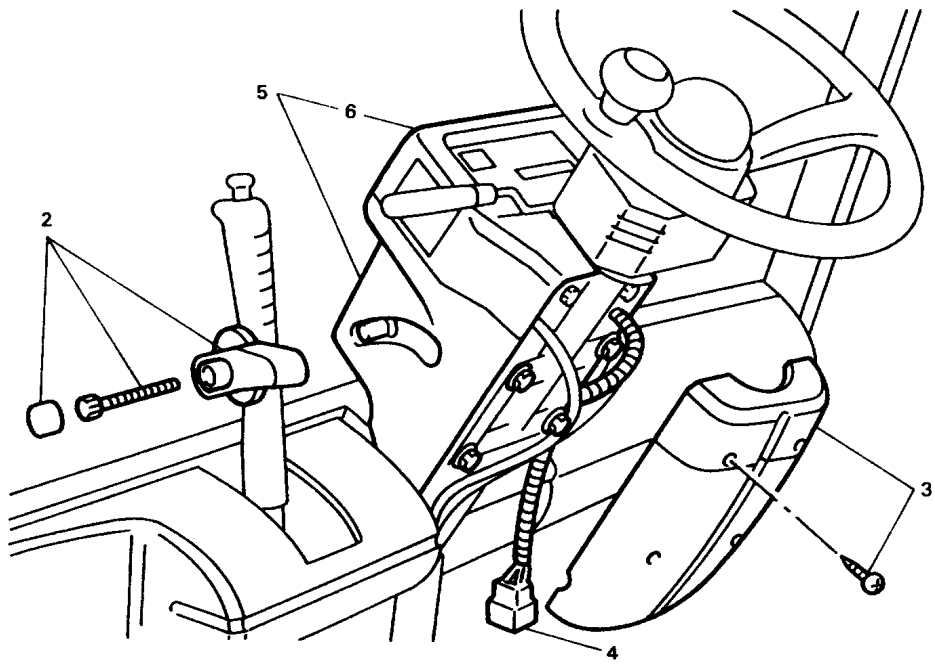
HOISTING THE VEHICLE

When hoisting the vehicle, sling the wire rope on the mast hook and the rear sides of headguard.

Caution:
Use wire ropes having sufficient strength.

COMBINATION METER

REMOVAL·INSTALLATION



1 Battery plug

Removal Procedure

1 Remove the battery plug.

2 Remove the tilt lock lever.

3 Remove the rear cover.

4 Disconnect the combination meter connector.

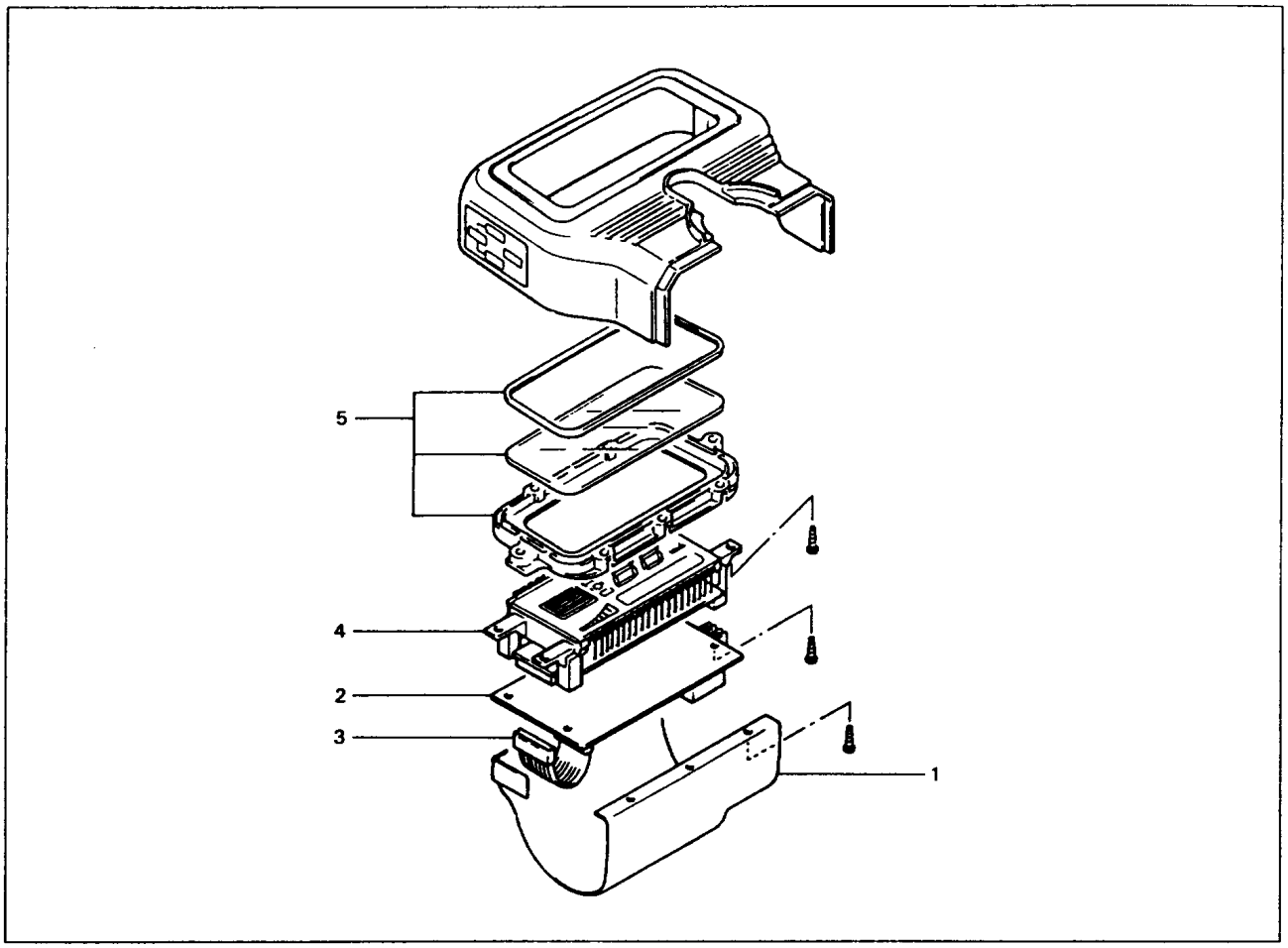
5 Remove the combination meter W/meter case.

6 Remove the combination meter.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

DISASSEMBLY·REASSEMBLY



Disassembly Procedure

1 Remove the sheet cover.

2 Remove the speed control switch.

3 Remove the wire harness.

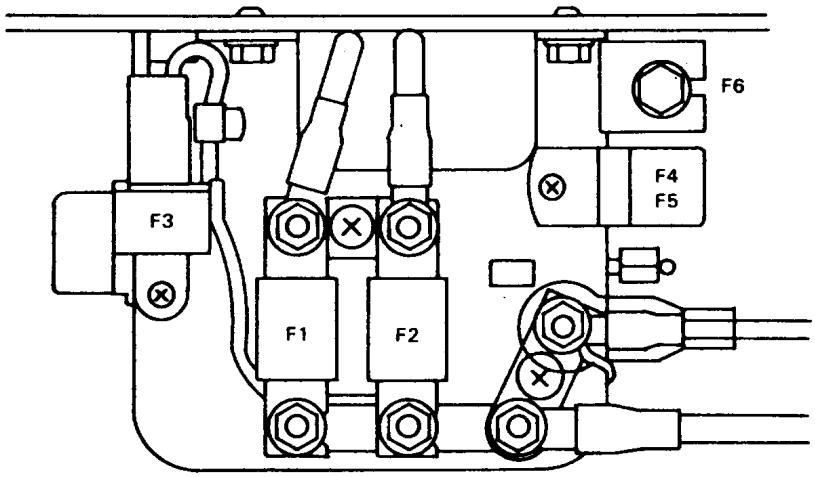
4 Remove the combination meter board.

5 Remove the panel ASSY, window plate, window glass and seal rubber.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

FUSE

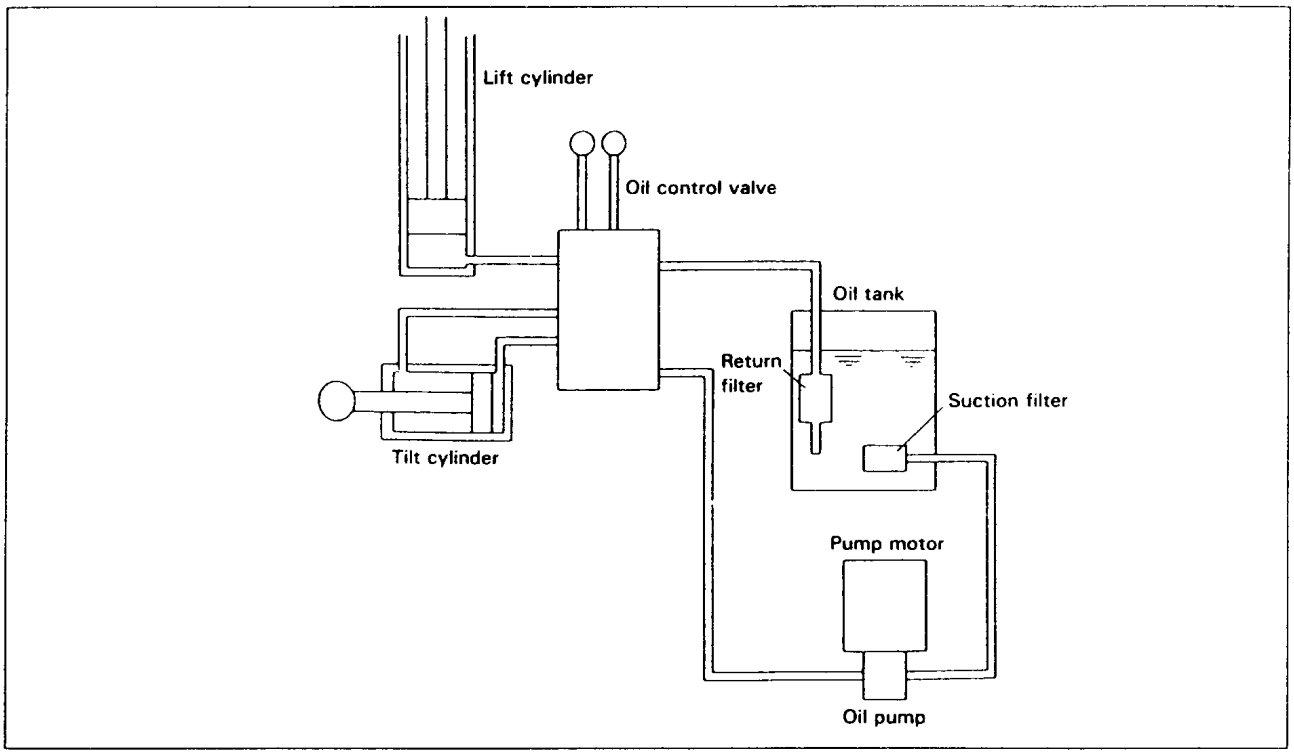


Fuse capacity: 48 V

Item / Model	F1 (DM)	F2 (PM)	F3 (PS)	F4 (Lamp) F5 (Control circuit)	F6 (DC-CD)
FBMF16	225A	200A	Up to 1999.8 : 60A From 1999.9 : 40A	10A	10A
FBMF20·25	325A	↑	↑	↑	↑
FBMF30	350A	225A	↑	↑	↑

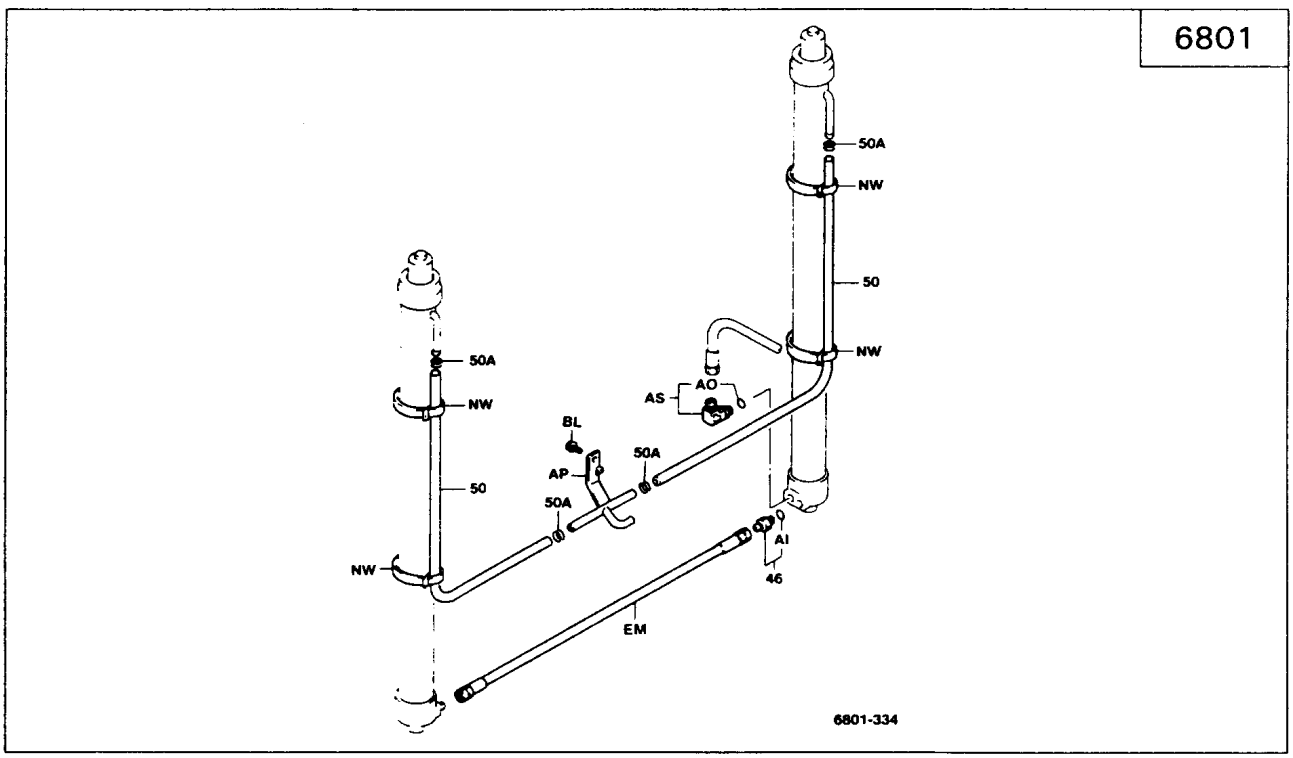
MATERIAL HANDLING SYSTEM

HYDRAULIC SYSTEM DIAGRAM

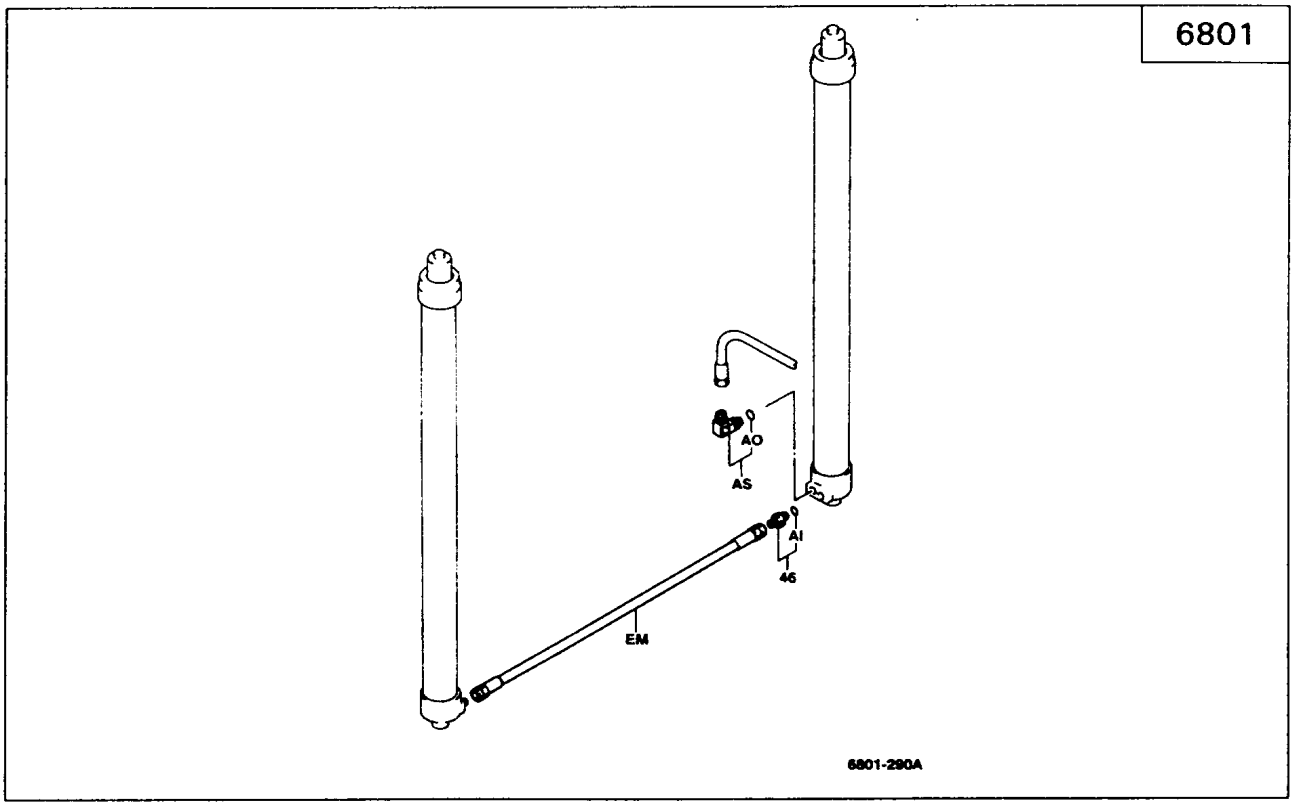


COMPONENTS

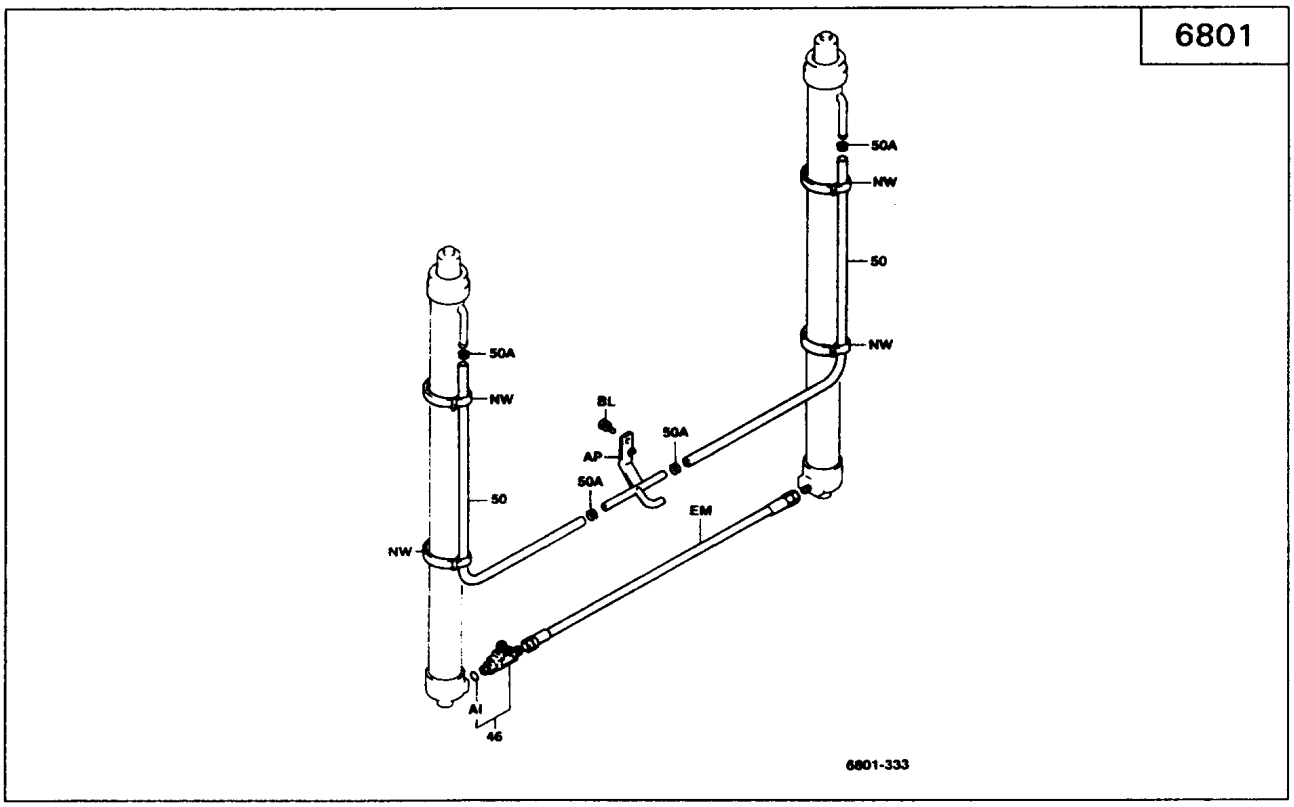
V Mast



FV Mast

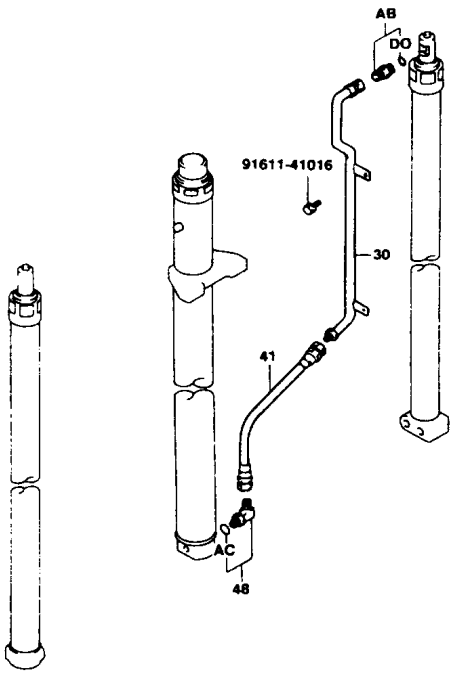


FSV Mast



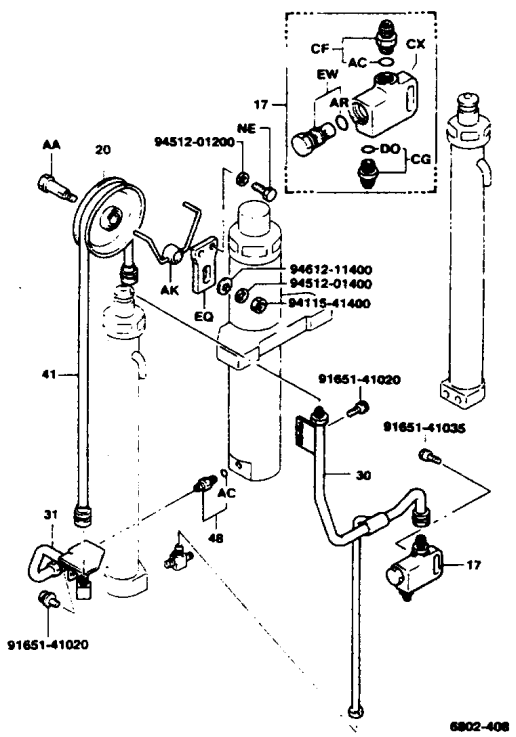
FV Mast

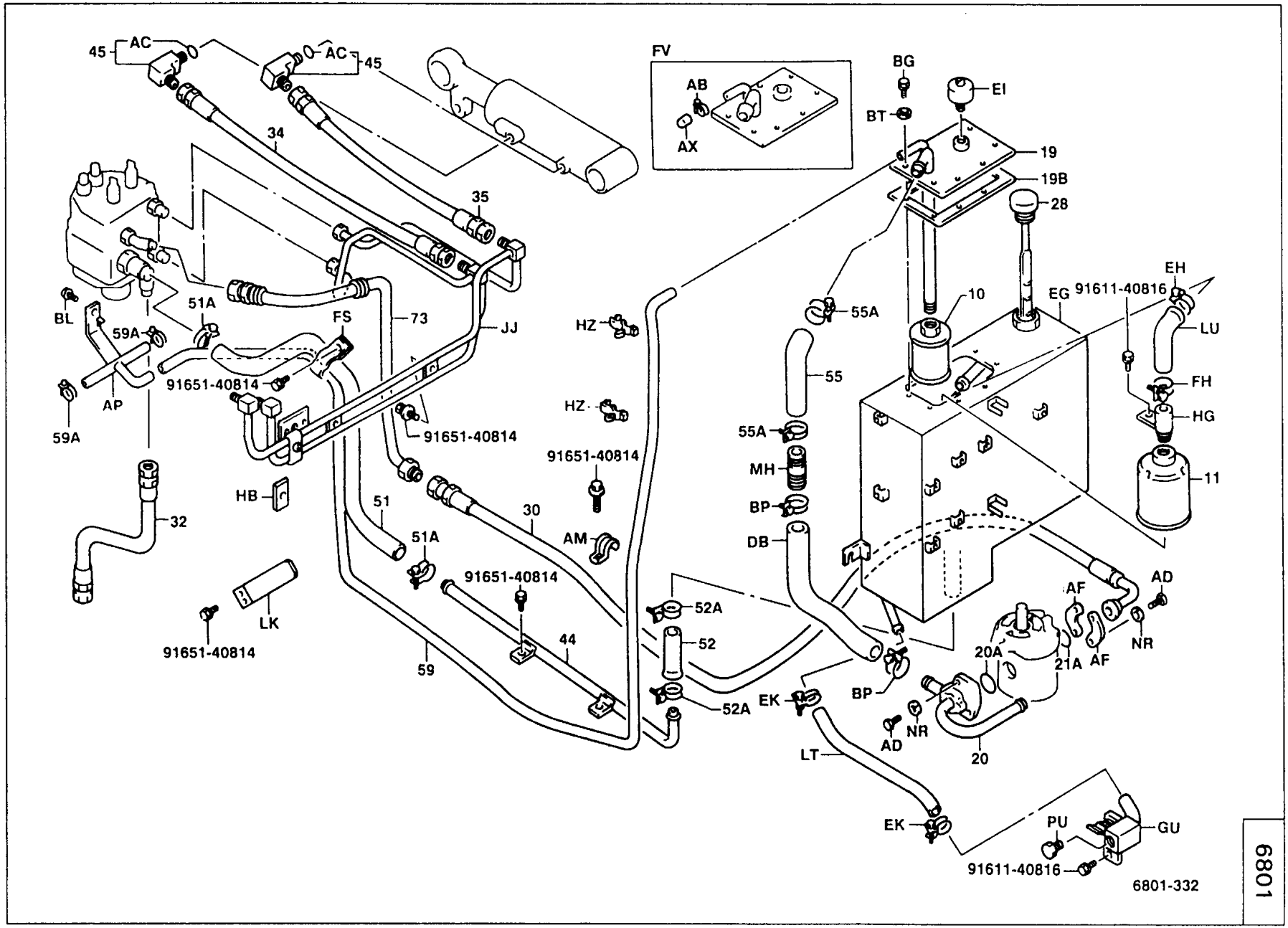
6802



FSV Mast

6802





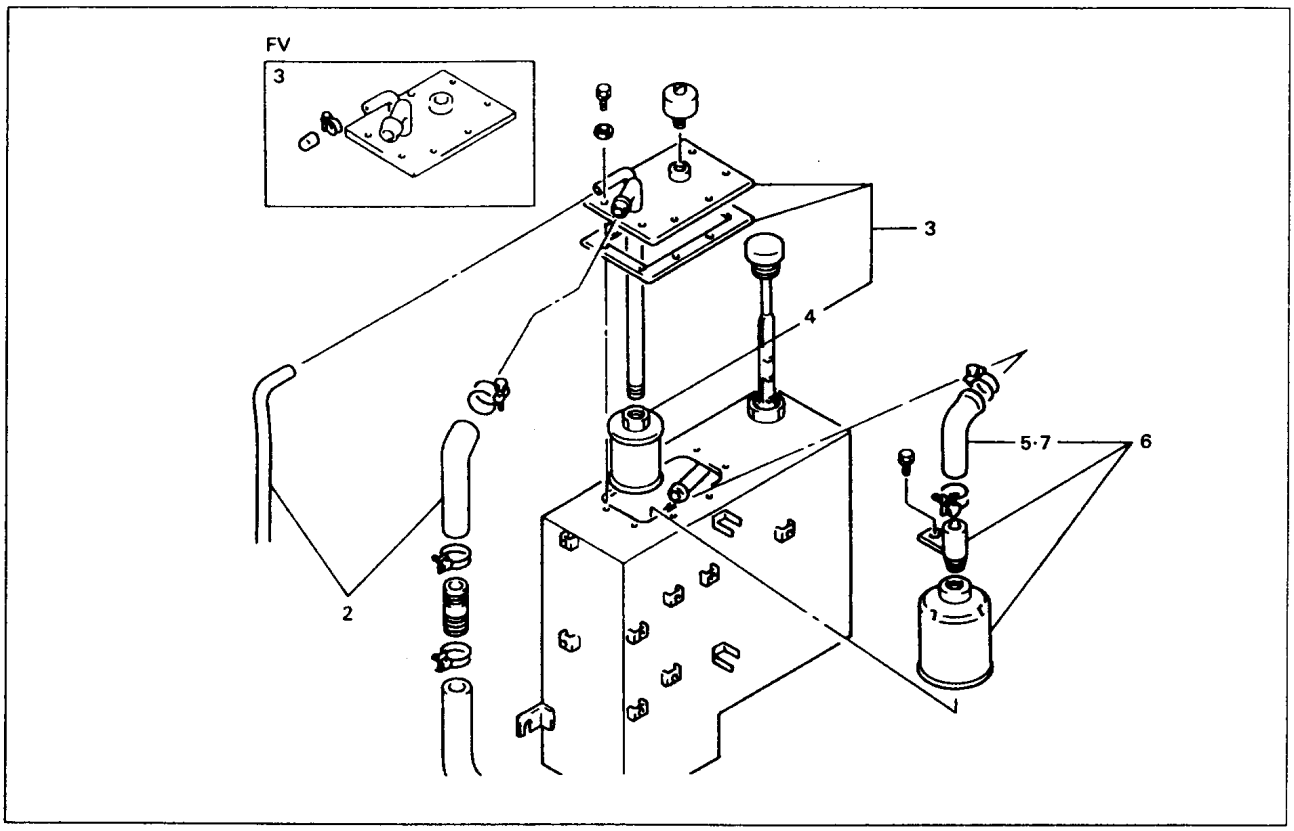
RETURN FILTER·SUCTION FILTER

SPECIFICATIONS

Oil Filter

Suction filter	Filtering precision	100 mesh
	Filtering area cm² (in²)	Approx. 2900 (449.5)
Return filter	Filtering precision	30 μm
	Filtering area cm² (in²)	Approx. 2000 (310)

REMOVAL·INSTALLATION

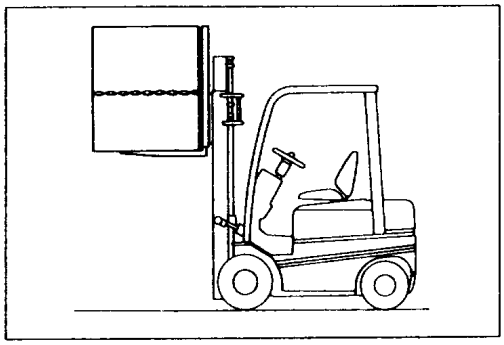


Removal Procedure

1 Remove the battery hood and rear hood W/hinge.
2 Disconnect the return hose and breather hose.
3 Remove the tank cover W/return filter.
4 Remove the return filter.
5 Disconnect the suction hose.
6 Remove the suction filter W/suction hose.
7 Remove the suction hose.

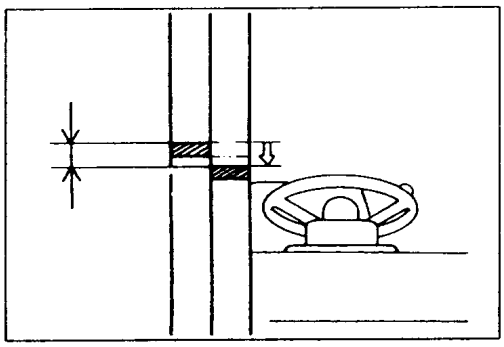
Installation Procedure

The installation procedure is the reverse of the removal procedure.



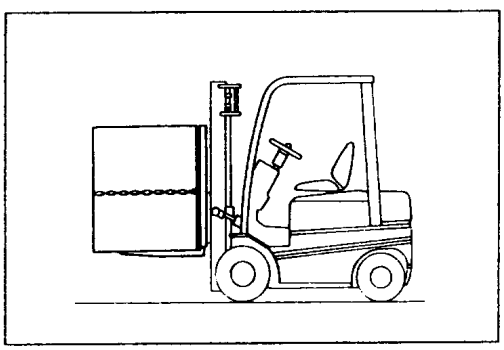
NATURAL DROP TEST

1. Set the mast in the vertical position with the standard load on the fork. Lift the fork by 1 to 1.5 m (40 to 50 in), and the key switch OFF.



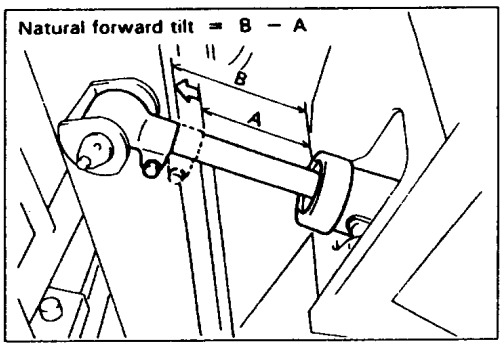
2. Draw datum lines on the inner and outer masts, and measure the drop in 15 minutes.

   Natural drop: 90 mm (3.54 in) or less



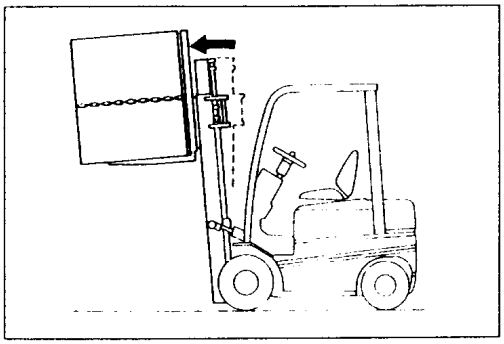
NATURAL FORWARD TILT TEST

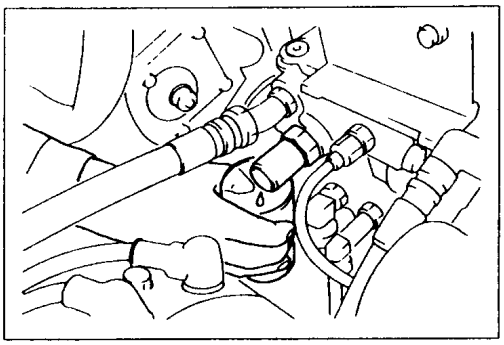
1. Set the mast in the vertical position with standard load on the fork. Lift the fork by about 50 cm (19.7 in), and the key switch OFF.

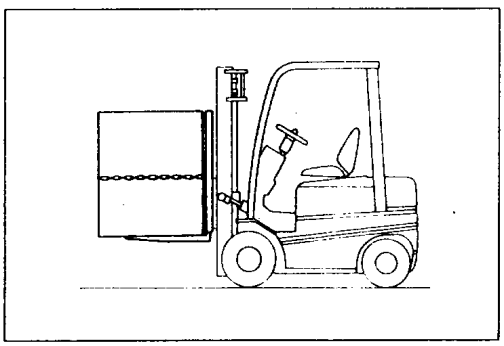


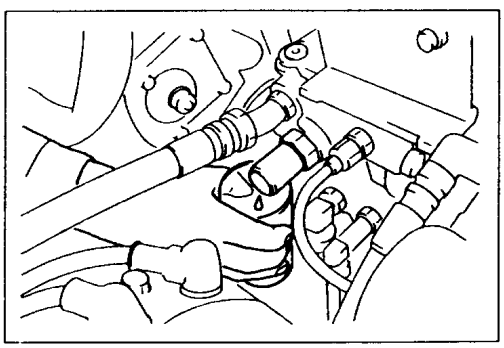
2. Measure the tilt cylinder rod extension in 15 minutes.

Model	Natural forward tilt amount mm (in)
FBMF16	30 (1.18) or less
FBMF20·25	45 (1.77) or less
FBMF30	↑









OIL LEAK TEST

LIFT CYLINDER

1. Set the mast in the vertical position with the standard load on the fork. Lift the fork by 1 to 1.5 m (40 to 59 in).

2. Slowly tilt the mast fully forward, and the key switch OFF.

3. After 5 minutes, disconnect the oil control valve to oil tank hose. Using a measuring cylinder, measure the amount of oil leaking in one minute.

   Standard oil leak amount (at lift port):
   16 cc (0.98 cu-in) or less

Note:
If the natural drop is great even though the oil leak amount is within the standard, the lift cylinder packing is defective.

TILT CYLINDER

1. Set the mast in the vertical position with standard load on the fork. Lift the fork by about 50 cm (19.7 in), and turn the key switch OFF.

2. After 5 minutes, disconnect the oil control valve to oil tank hose. Using a measuring cylinder, measure the amount of oil leaking in one minute.

   Standard oil leak amount (total for lift and tilt):
   34 cc (2.07 cu-in) or less

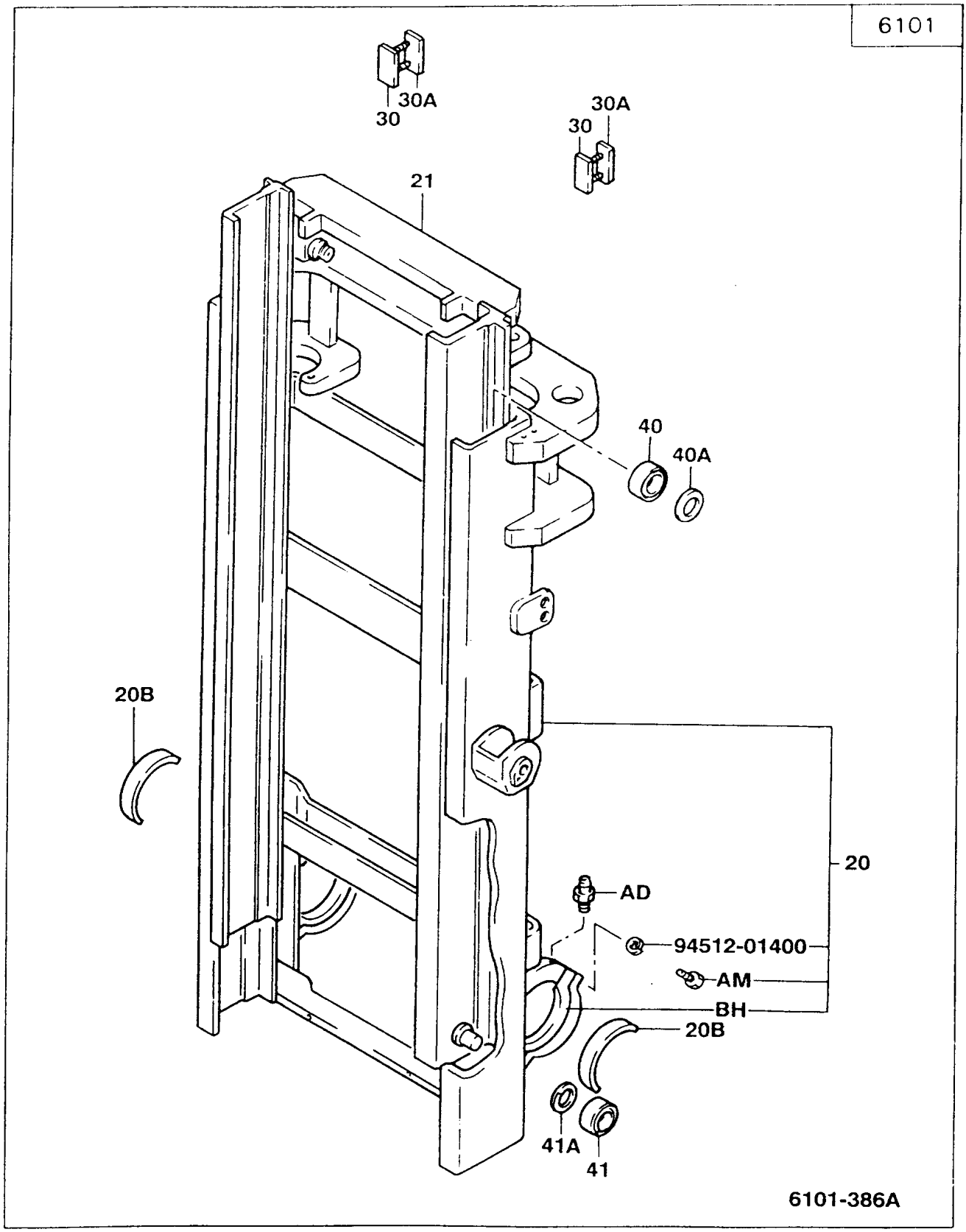
3. The leak amount at the tilt port is the total leak amount less the leak amount from the lift port.

Note:
If the natural forward tilt is great even though the oil leak amount is within the standard, inspect the tilt lock valve or the tilt cylinder packing because it may be defective.

MAST

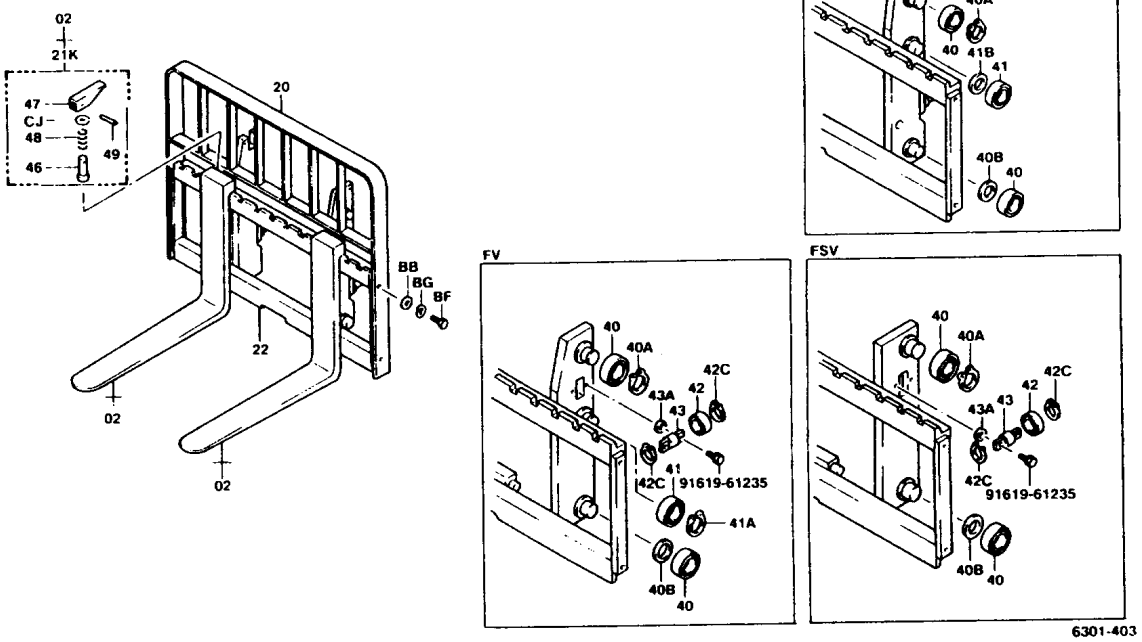
V MAST ASSY

COMPONENTS

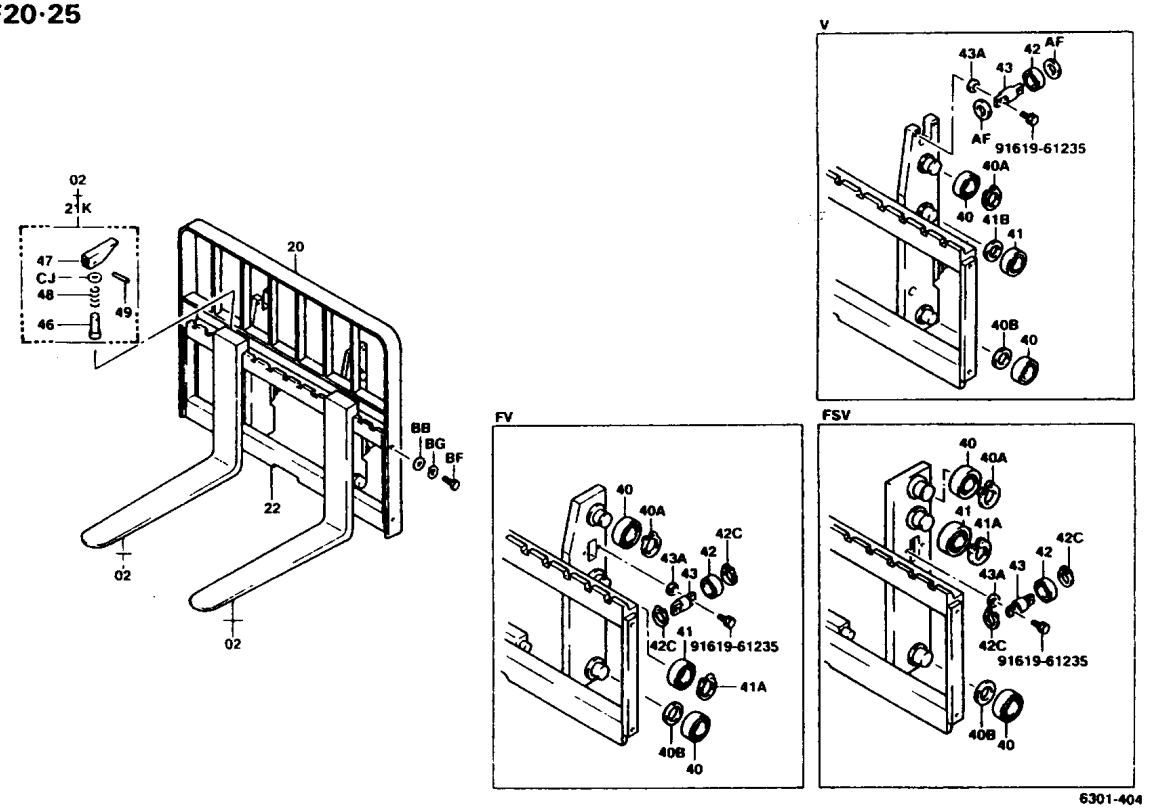


6301

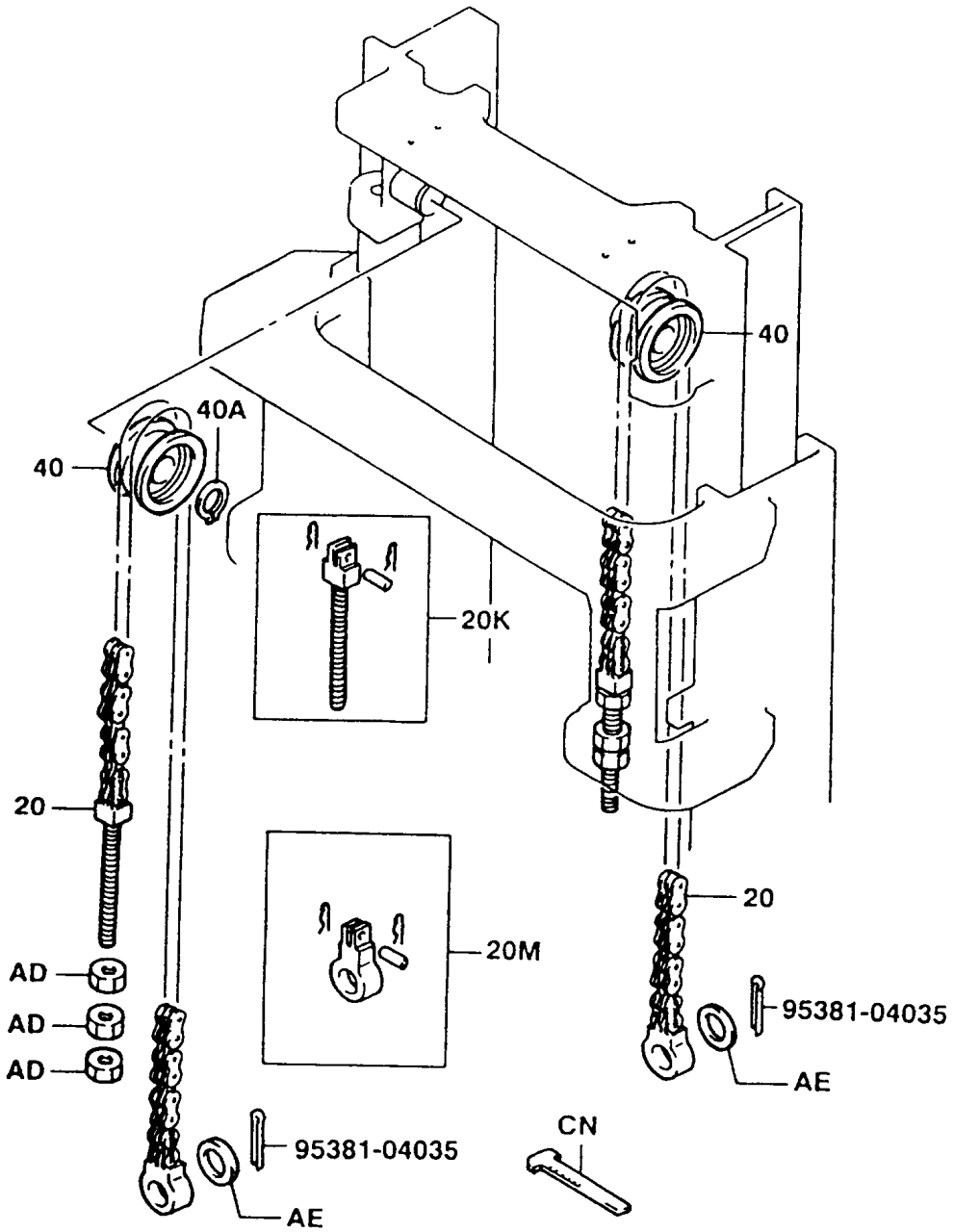
FBMF16·30



FBMF20·25

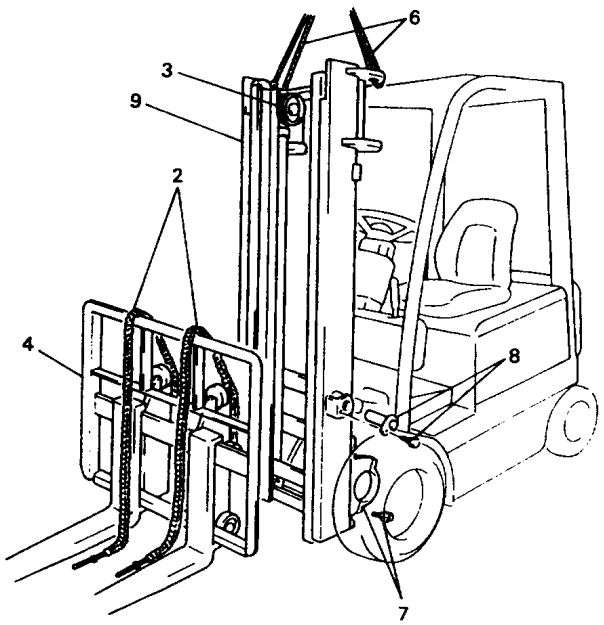


6302



6302-301

REMOVAL·INSTALLATION



1 Mast in vertical position and fork at the lowermost position
5 Hose

Removal Procedure

1 Set the mast vertical and lower the fork to the bottom position.

2 Disconnect the chain.

3 Remove the chain wheel. **[Point 1]**

4 Remove the lift bracket. (Raise the inner mast until it comes off from the lift bracket, and slowly move the vehicle in the reverse direction to depart from the lift bracket. Then turn the key switch OFF.)

5 Disconnect the overflow hose and high pressure hose. (Lower the inner mast to the bottom position and operate the lift lever several times to release the residual pressure in the lift cylinder before disconnecting the hoses.)

6 Slightly hoist the mast.

7 Remove the mast support caps. **[Point 2]**

8 Remove the tilt cylinder front pin. **[Point 3]**

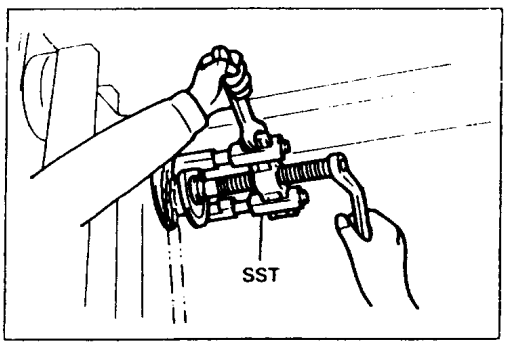
9 Remove the mast ASSY.

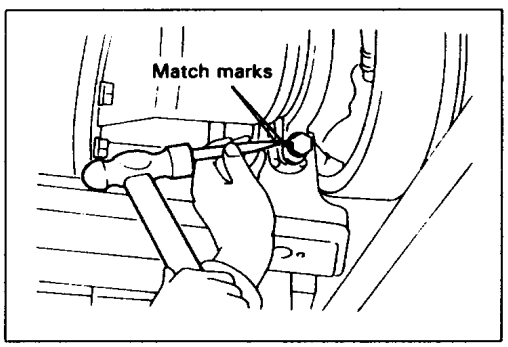
Installation Procedure

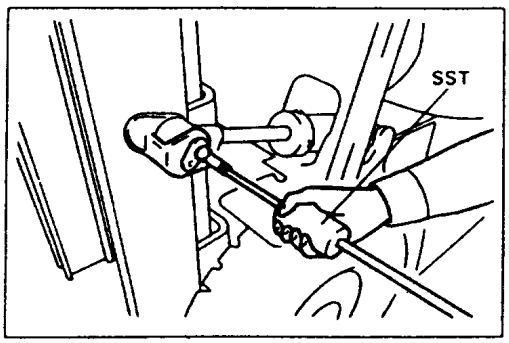
The installation procedure is the reverse of the removal procedure.

Note:

- **Apply MP grease on the interior surface of the mast support bushing, inner surface of the mast support cap and tilt cylinder front pin.**
- **Mast support cap set bolt tightening torque:**
  T = 68.65 ~ 107.87 N·m (700 ~ 1100 kgf-cm) [50.65 ~ 79.59 ft-lbf]
- **If any of the mast ASSY, outer mast, inner mast and lift cylinder is replaced, it is necessary to inspect and adjust uneven motion of the lift cylinder. See the lift cylinder rod shim adjustment section (on page 15-29) for the inspection and adjustment method.**
- **Adjust the chain tension. (See page 15-17.)**







Point Operations

[Point 1]

Removal: Use the SST for removal if the fitting is tight.
SST 09950-76014-71 (SST 09950-40011)

Installation: Install the chain wheel with its side having greater radius at the periphery of its hole facing the boss of the mast side pin.

[Point 2]

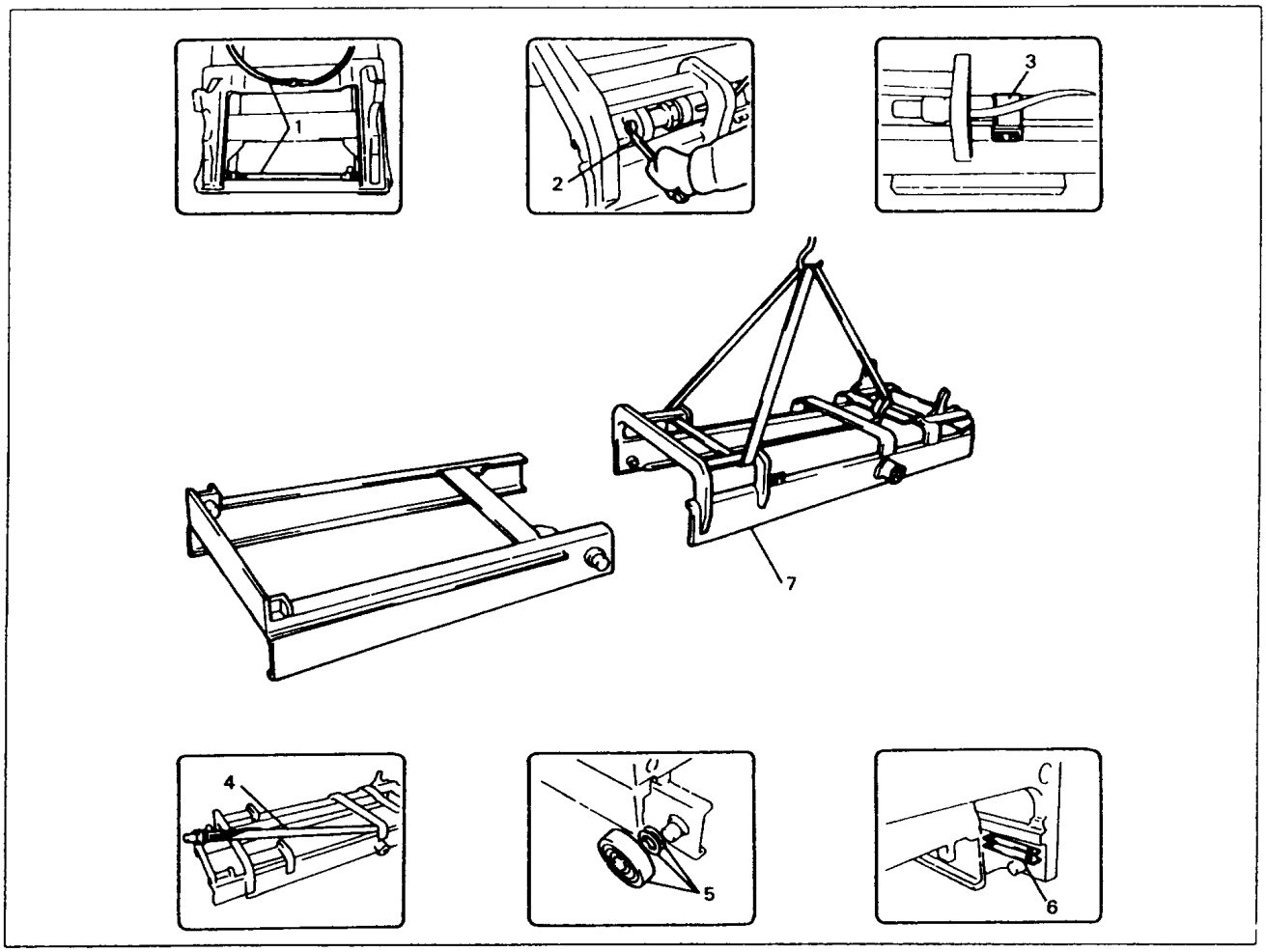
Removal: Punch match marks on the mast and support cap.

Installation: Align the match marks.

[Point 3]

Removal: SST 09810-20172-71

MAST DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

1 Disconnect the overflow hose and high pressure hose.

2 Remove the cylinder rod end set bolt and disconnect the rod end. **[Point 1]**

3 Remove the cylinder support. **[Point 2]**

4 Remove the cylinder bottom set bolts and remove the lift cylinder.

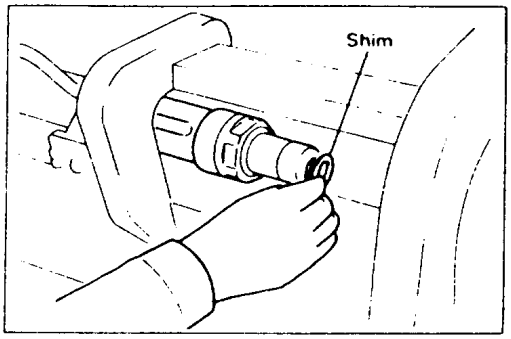
5 Slide the inner mast in the lowering direction and remove the lift rollers.

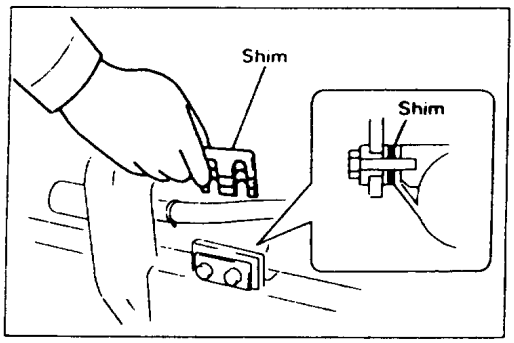
6 Remove the mast strip. **[Point 3]**

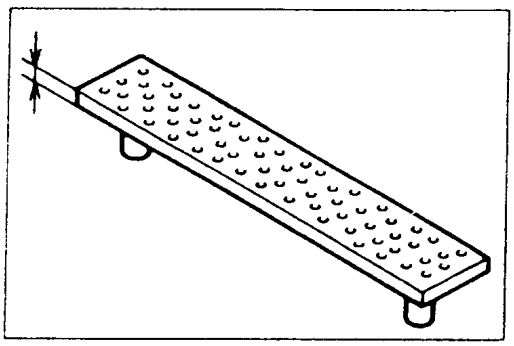
7 Remove the outer mast.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.







Point Operations

[Point 1]

Disassembly: Shim adjustment has been made at the lift cylinder rod end for prevention of cylinder uneven motion between the left and right sides. Take a note on which side the shim adjustment is made and the number of shims used.

[Point 2]

Disassembly: Take a note on the number of cylinder support shims used.

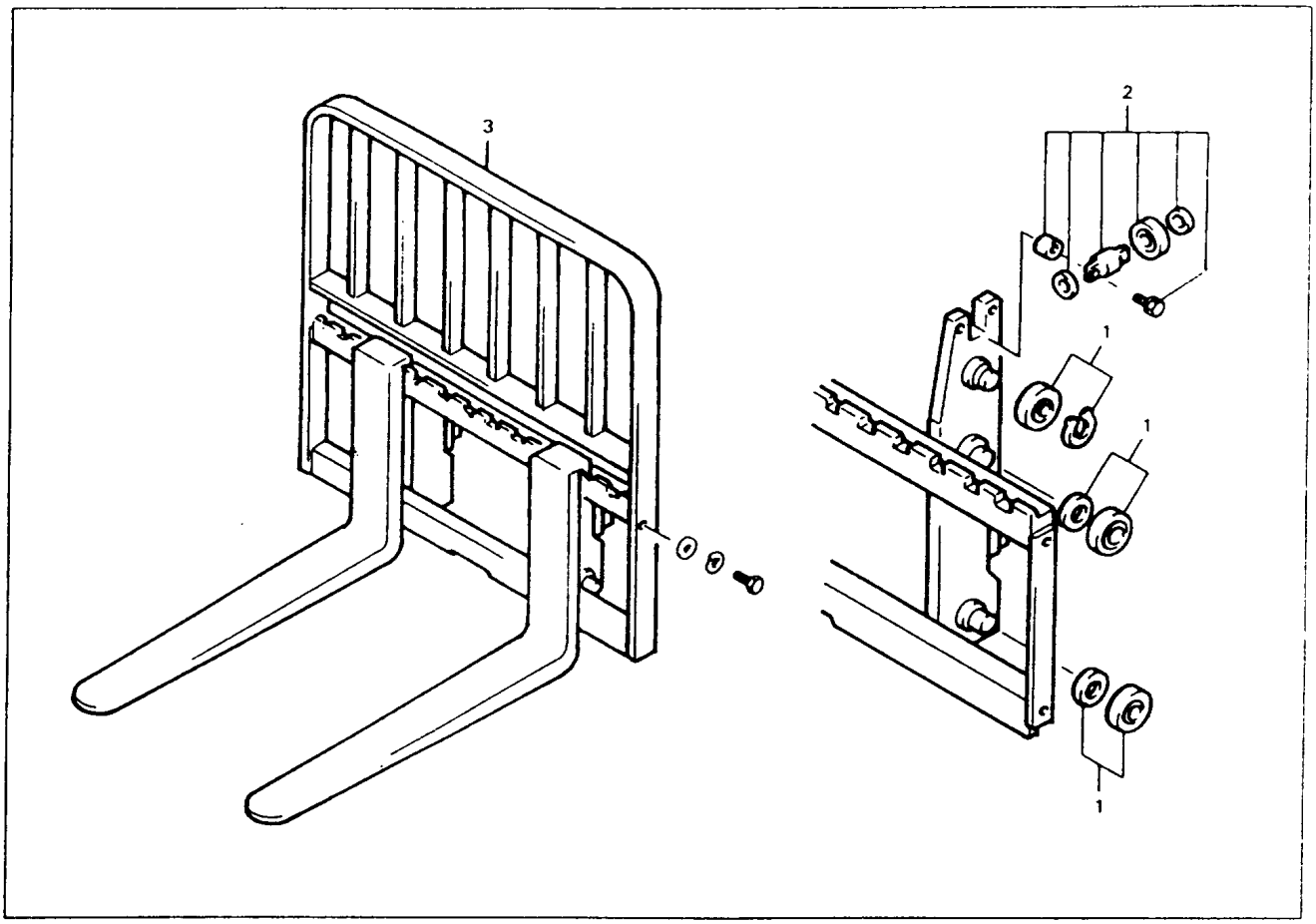
Reassembly: When the mast or cylinder is replaced, make shim adjustment at the cylinder support. With the cylinder rod end inserted to the inner mast, eliminate the clearance between the cylinder support and outer mast by inserting shims. The shim thickness should be slightly thicker.

[Point 3]

Inspection: Measure the mast strip thickness.

Thickness limit: 1.5 mm (0.059 in)

LIFT BRACKET DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

1 Remove the lift rollers. [Point 1]

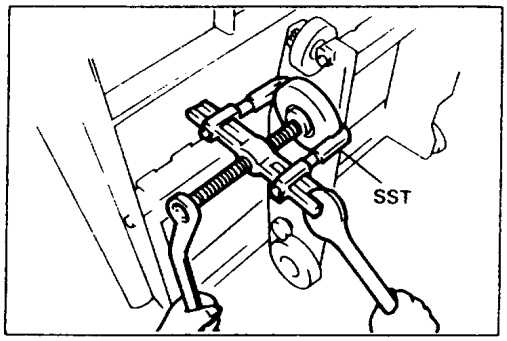
2 Remove the side rollers. [Point 2]

3 Remove the back rest.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

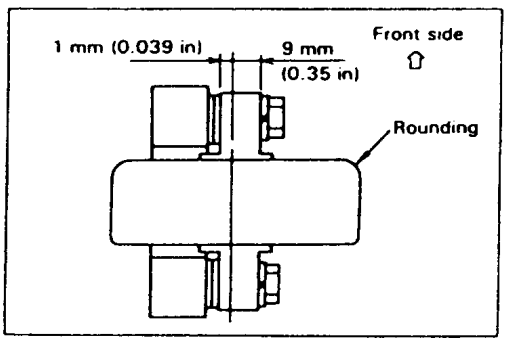
Note:
Back rest set bolt tightening torque T = 99.54 ~ 184.86 N·m (1015 ~ 1885 kgf-cm) (73.44 ~ 136.38 ft-lbf)



Point Operations

[Point 1]

Disassembly: SST 09950-76014-71 (SST 09950-40011)

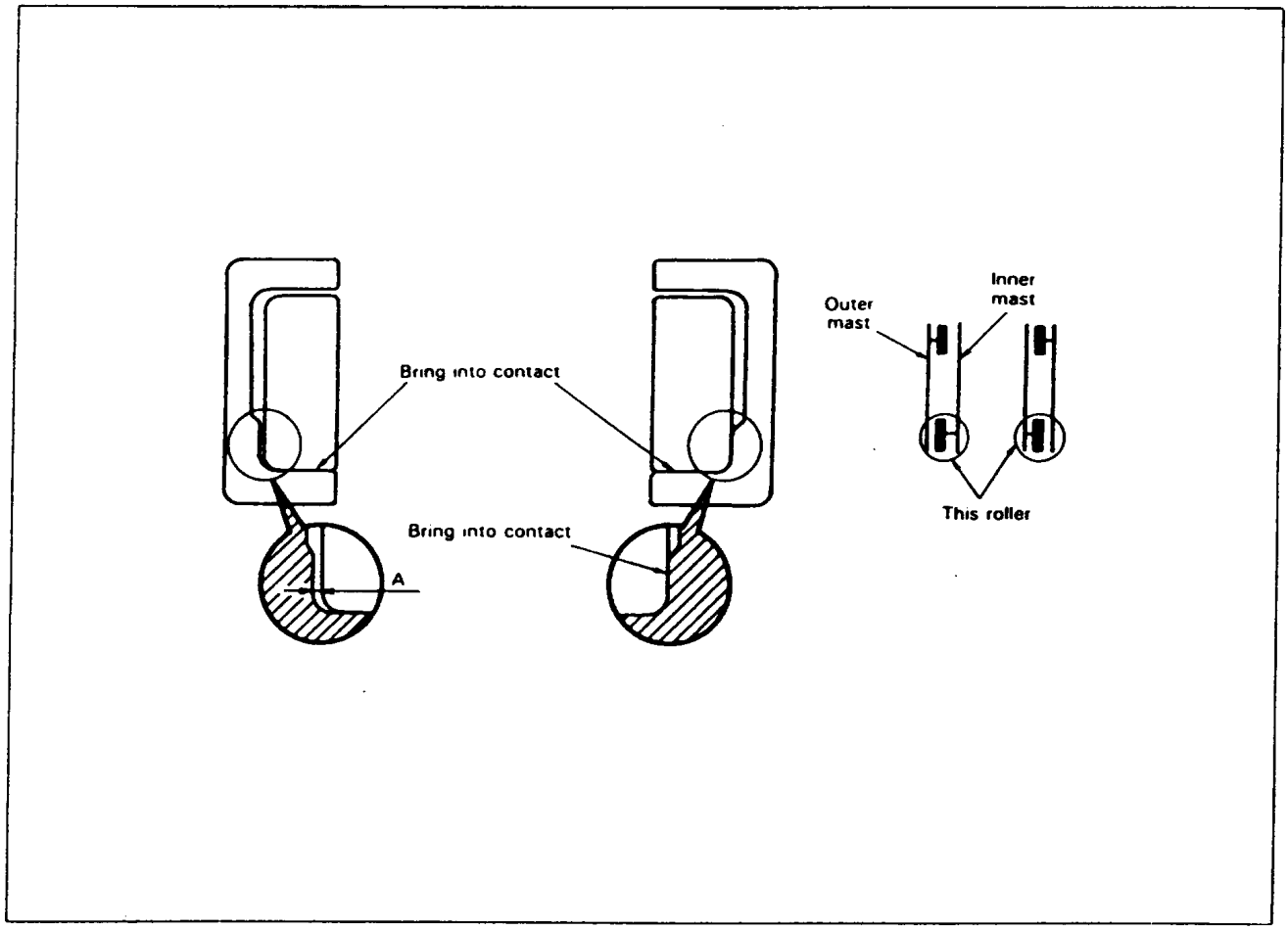


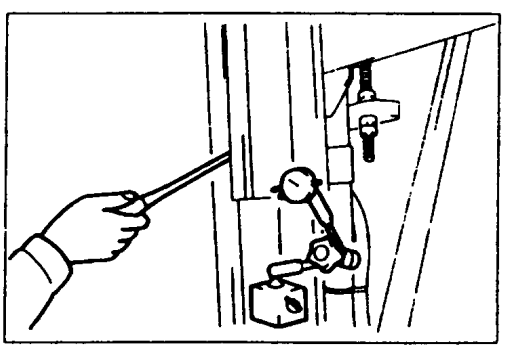
[Point 2]

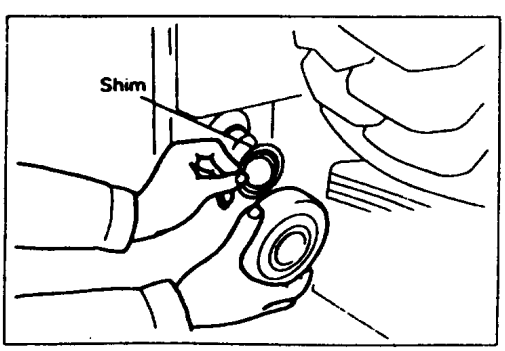
Reassembly: Do not mistake the side roller mounting direction.
The side where the chamfering radius of the roller outer circumference shall face the front side.

MAST ADJUSTMENT

Mast Lift Roller Adjustment



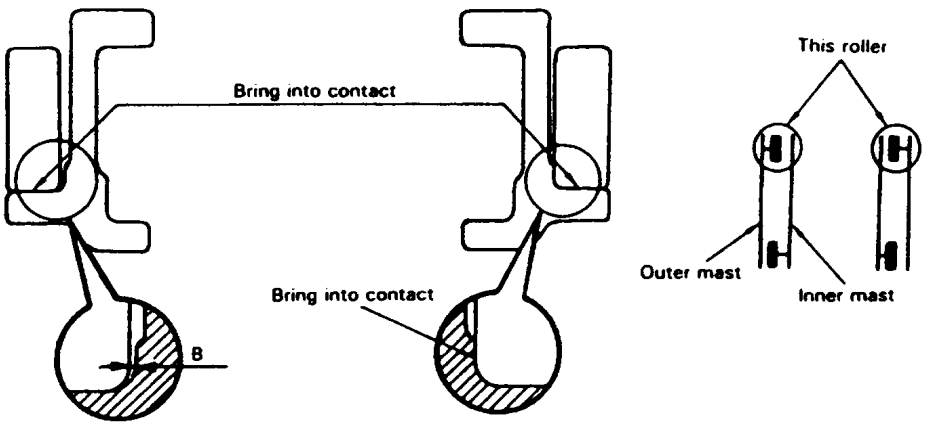


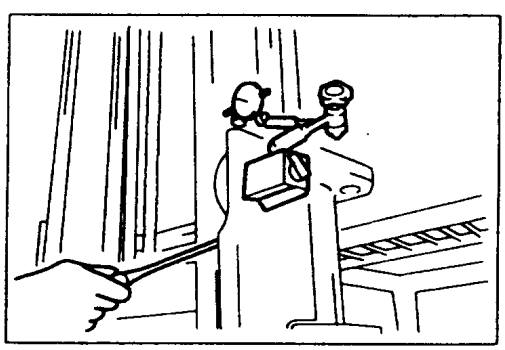


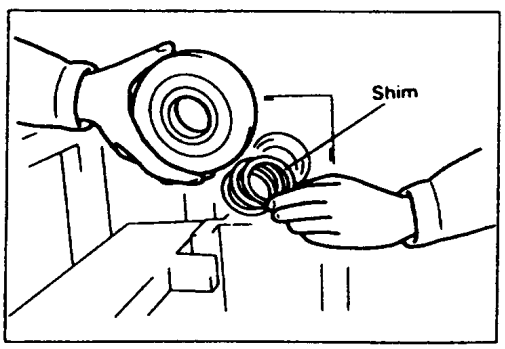
1. Inner mast roller clearance adjustment
   (1) Measure the clearance with the mast overlap at about 450 mm (17.72 in).
   (2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner mast roller shim.

   Standard clearance A = 0 ~ 0.8 mm (0 ~ 0.031 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

   (3) Distribute the shim thickness equally to the left and right rollers. (See the "mast roller removal·installation" section for the shim replacement procedure.)
   (4) After the adjustment, check that the inner mast moves smoothly in the outer mast.



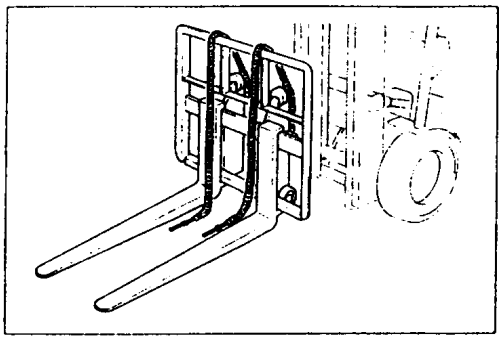


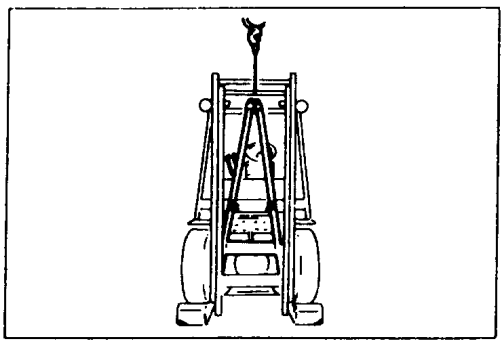


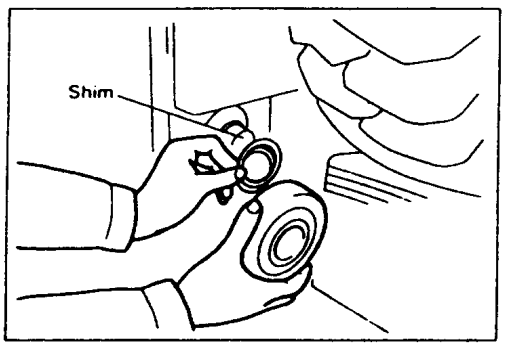
2. Outer mast roller clearance adjustment
   (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
   (2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer mast roller shim:

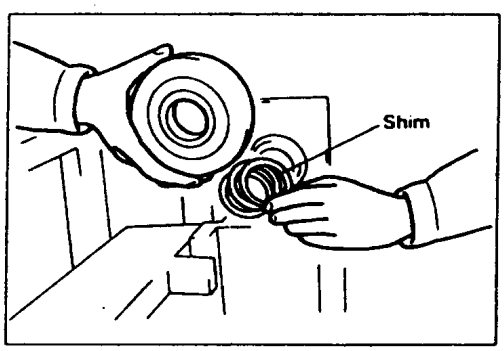
   Standard clearance B = 0 ~ 0.8 mm (0 ~ 0.031 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

   (3) Distribute the shim thickness equally to the left and right sides. (See the "mast roller removal·installation" section for the shim replacement procedure.)
   (4) After the adjustment, check that the inner mast moves smoothly in the outer mast.









Mast Roller Removal·Installation

1. Remove the lift bracket. (See the mast ASSY removal procedure steps 1 to 4 on page 15-5.)

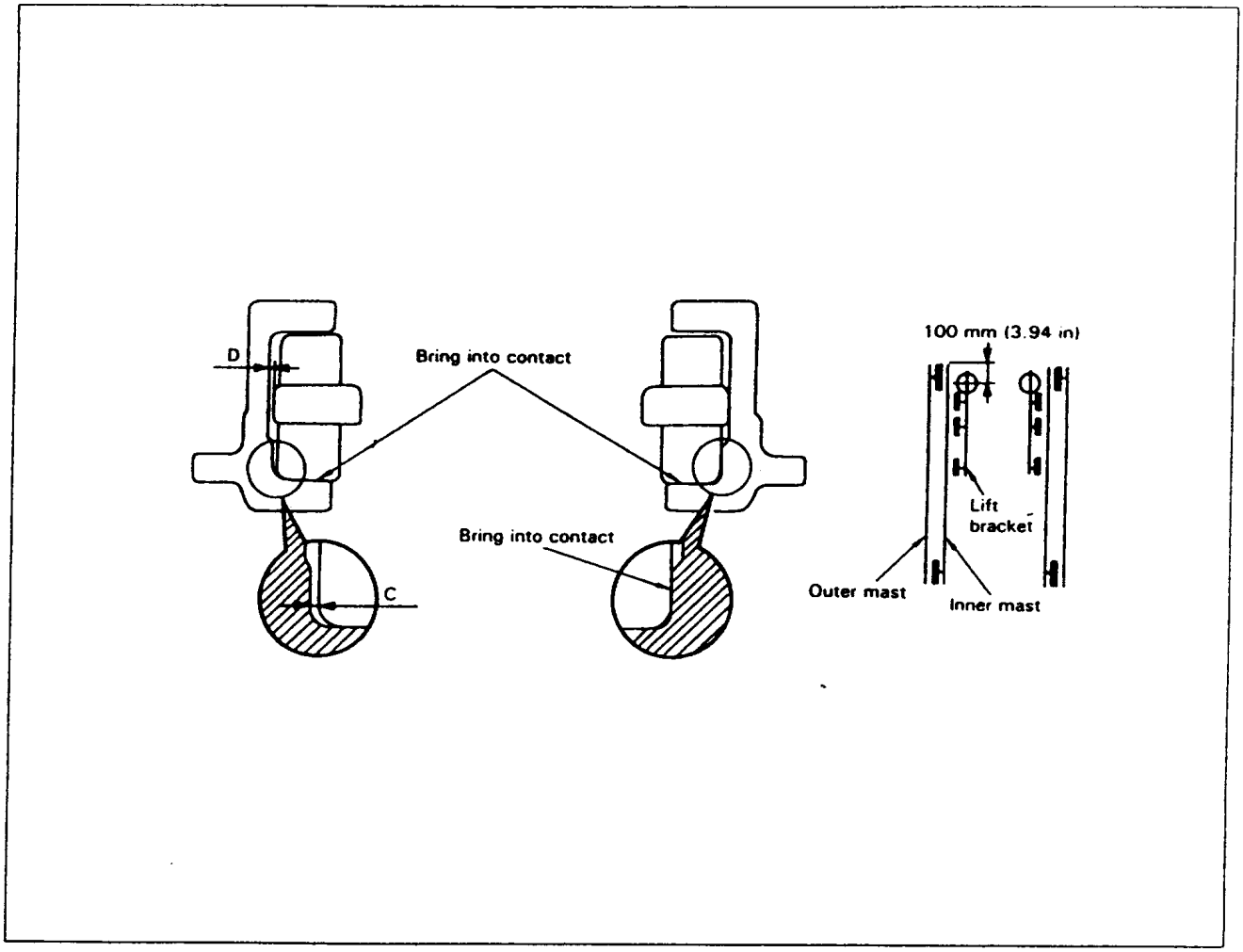
2. Jack up the vehicle and support the tires with wooden blocks. Lock the front and rear tires to prevent rotation.

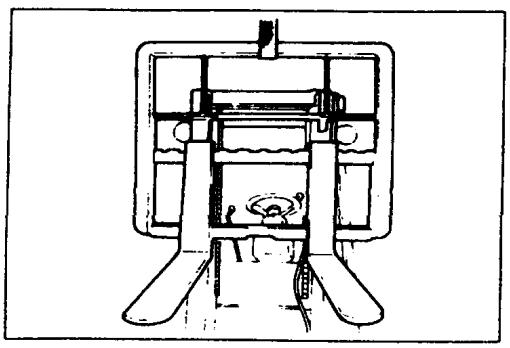
3. Tilt the lift cylinder.
   (1) Remove the hose cover at the bottom of the mast and disconnect the lift cylinder hose on the LH side.
   (2) Remove the lift cylinder bottom set bolts.
   (3) Sling the inner mast upper tie beam with a wire and slightly hoist it.
   (4) Remove the lift cylinder rod end set bolts, and disconnect the rod end by hoisting the inner mast.
   (5) Remove the lift cylinder support.
   (6) Tilt the lift cylinders LH and RH and tie them with ropes to the outer mast tie beam.

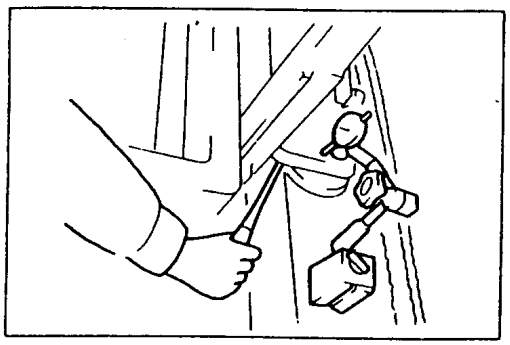
4. Remove the mast rollers.
   (1) Lower the hoisted inner mast slowly until mast rollers are visible, and support the bottom with wooden blocks.
   (2) Remove the inner mast rollers and shims.
   (3) Remove the outer mast rollers and shims.

5. The installation procedure is the reverse of the removal procedure.

Lift Bracket Roller Adjustment

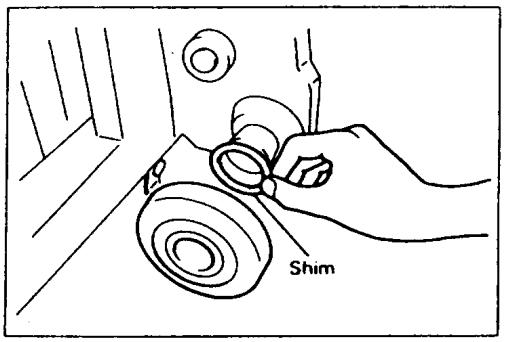




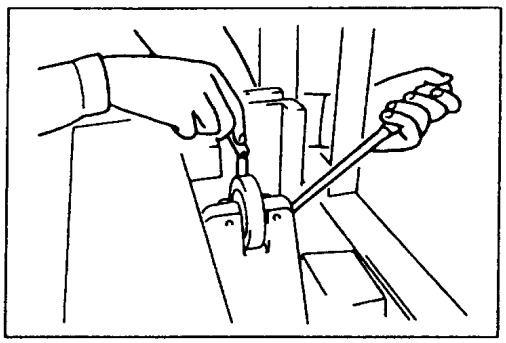


1. Lift roller and side roller clearance adjustment
   (1) Measure the clearance when the center of the lift bracket upper side roller is 100 mm (3.93 in) from the top of the inner mast.
   (2) The upper lift rollers need no adjustment because they are fixed by snap rings.
   (3) Measure the clearances at the middle and lower lift rollers after removing the side rollers.
   Shift the lift bracket to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

   Standard clearance **C = 0 ~ 0.8 mm (0 ~ 0.031 in)**
   Shim thickness: **0.5 and 1.0 mm (0.020 and 0.039 in)**

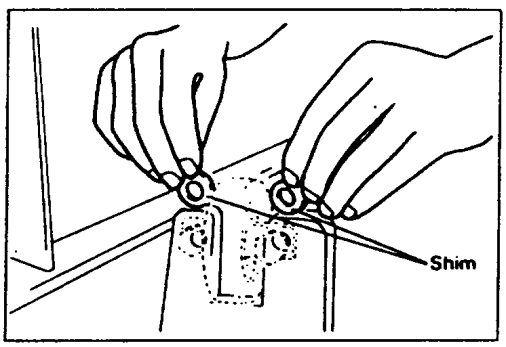


(4) Distribute the shim thickness equally to the left and right sides. (For the shim replacement procedure, see the lift bracket disassembly section on page 15-9.)
(5) Install the side rollers.



(6) Side roller adjustment shall be made after adjusting the middle and lower lift rollers.
Bring the side roller on one side into contact with the mast side surface, and make adjustment by shim insertion to make the clearance between the side roller and inner mast side surface on the opposite side satisfy the following standard.

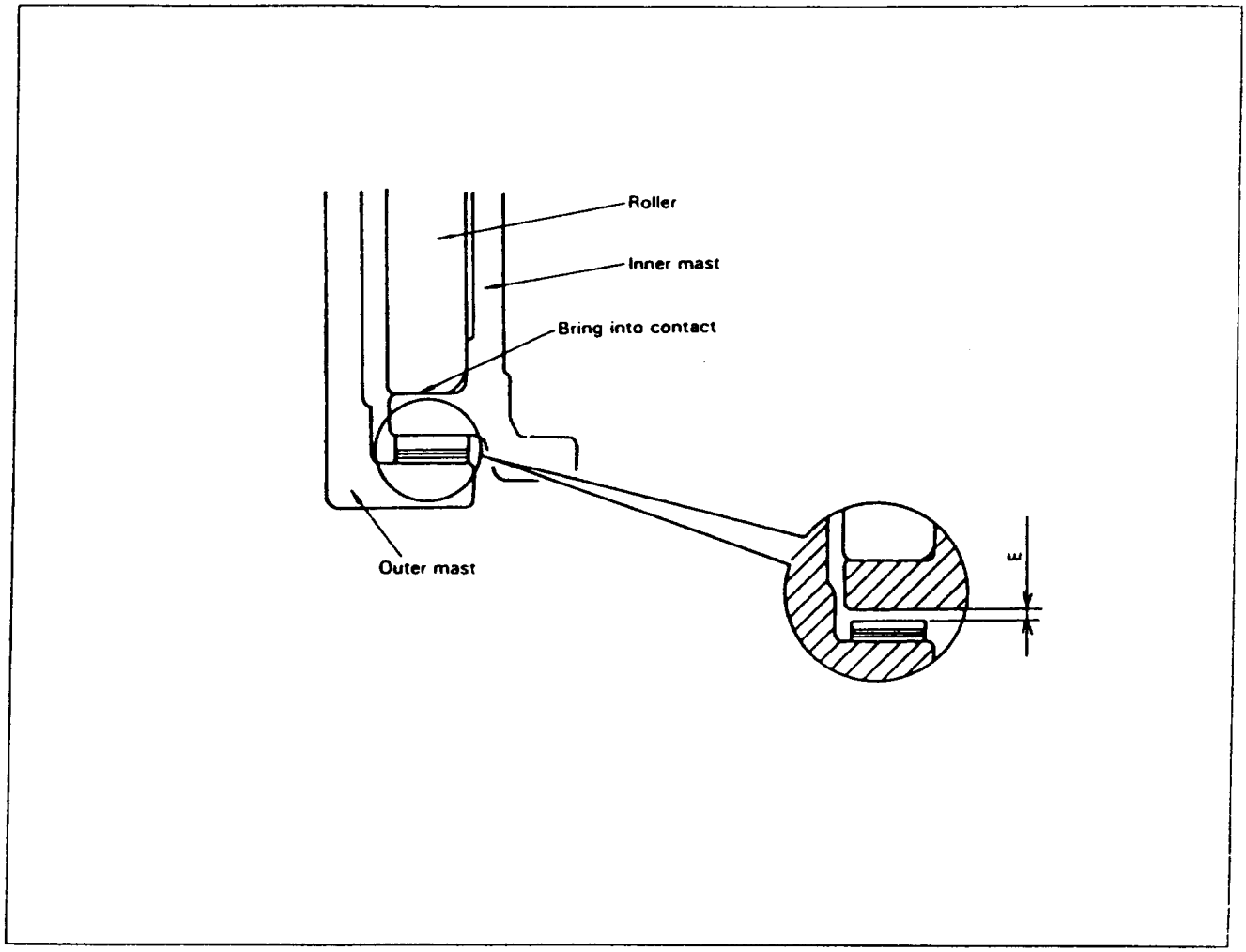
Standard clearace **D = 0 ~ 0.6 mm (0 ~ 0.024 in)**
Shim thickness: **0.5 and 1.0 mm (0.020 and 0.039 in)**

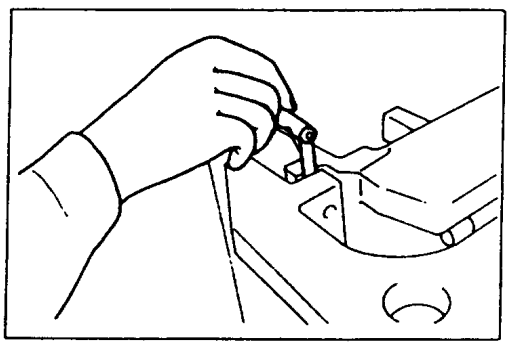


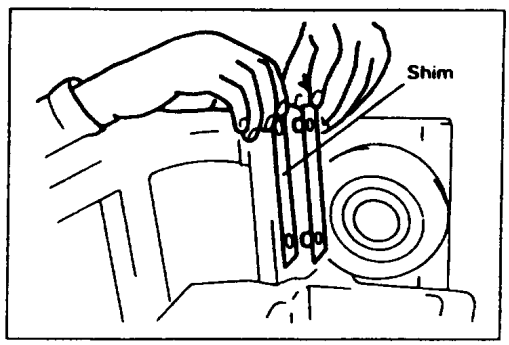
(7) The shim thickness shall be distributed equally into the left and right sides. (Shim replacement is possible on the vehicle. For the side roller installation, see the lift bracket disassembly section on page 15-9.)

2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

Mast Strip Adjustment



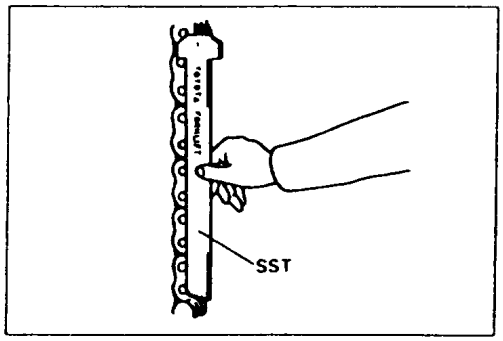




1. Mast strip clearance adjustment
   (1) Measure the clearance with the inner mast at the bottom position.
   (2) With the inner mast in contact with the outer mast roller, adjust the clearance between the mast strip and inner mast to the following value by inserting the mast strip shim. (The shim replacement procedure is the same as that described in the "mast roller removal-installation" section on page 15-13.)

   Standard clearance **E = 0.5 ~ 1.0 mm (0.020 ~ 0.039 in)**
   Shim thickness: **0.5 and 1.0 mm (0.020 and 0.039 in)**

   (3) After the adjustment, the mast should move smoothly.



CHAIN

INSPECTION

1. Inspect the chain elongation.
   SST 09631-22000-71

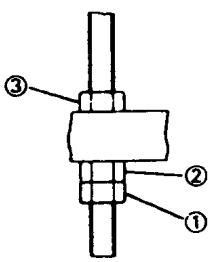
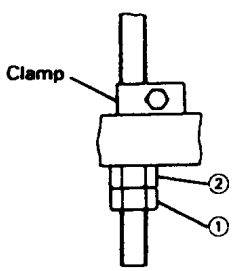
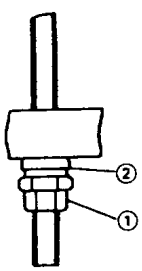
Note:
- **When inspecting the chain elongation, use the SST above and inspect without removal from the vehicle.**
- **Standard chain link pitch**
  FBMF16: 15.88 mm (0.6252 in) (Type: BL534)
  FBMF20·25: 19.05 mm (0.7500 in) (Type: BL634)
  FBMF30: 25.4 mm (1.000 in) (Type: BL823)

REASSEMBLY

Chain Adjusting Nut Tightening Sequence

1 Tighten nuts ① and ②.
T = 49.03 ~ 78.45 N·m (500 ~ 800 kgf-cm) [36.18 ~ 57.88 ft-lbf]

2 Tighten nuts ③. **T = 49.03 ~ 78.45 N·m (500 ~ 800 kgf-cm) [36.18 ~ 57.88 ft-lbf]**

Applicable mast and portion	V: Outer mast	FV: Front cylinder FSV: Front cylinder SV: Outer mast (maximum fork height at 2700 (106 in) or less)	FSV: Outer mast SV: Outer mast (maximum fork height 3000 (118 in) or more)
Sketch			

ADJUSTMENT

1 Place the vehicle on a flat ground, and set the mast in the vertical position.

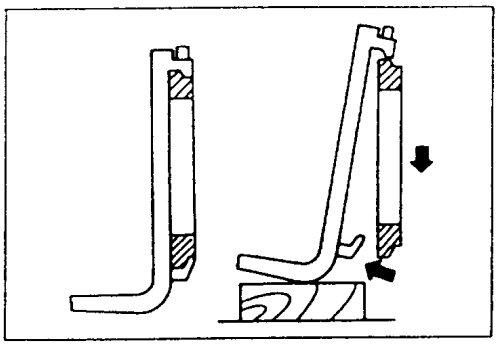
2 After moving the fork up and down several times without a load, check that the chain tension on the left and right sides are equal.

3 Turn the adjusting nut so that the fork bottom surface is about to come into contact with the ground surface without slackening the chain.

4 Check the chains for equal tension on the left and right sides.

5 Check that the chains are not twisted.

6 Check that the maximum fork height is as specified.



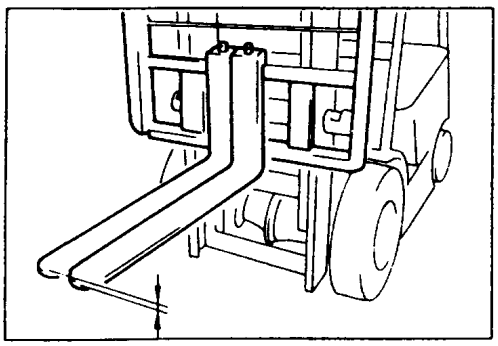
FORK

REMOVAL

1. Position the fork at 20 cm (7.9 in) above the ground.
2. Place a wooden block under the notched portion of the fork rail.
3. Unlock after lifting the fork stopper pin, and shift the fork blades one by one to the center.
4. Gradually lower the fork and remove it.

INSTALLATION

The installation procedure is the reverse of the removal procedure.



INSPECTION

1. Inspect the fork.

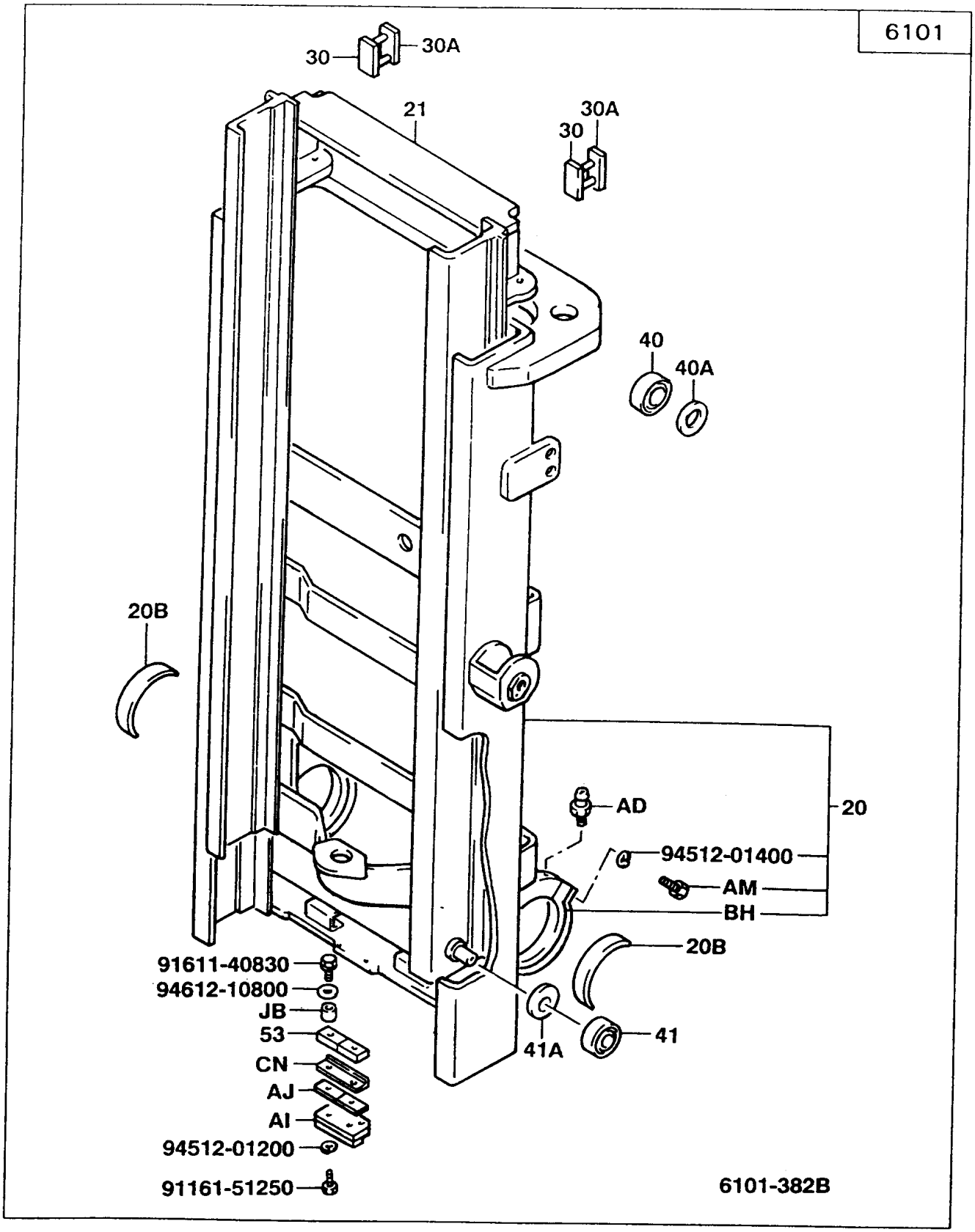
   Fork tip end limit misalignment: 10 mm (0.39 in)

Note:
If the tip end limit misalignment is exceeded, inspect the bend, fork mounting looseness and lift bracket finger bar distortion for each blade.

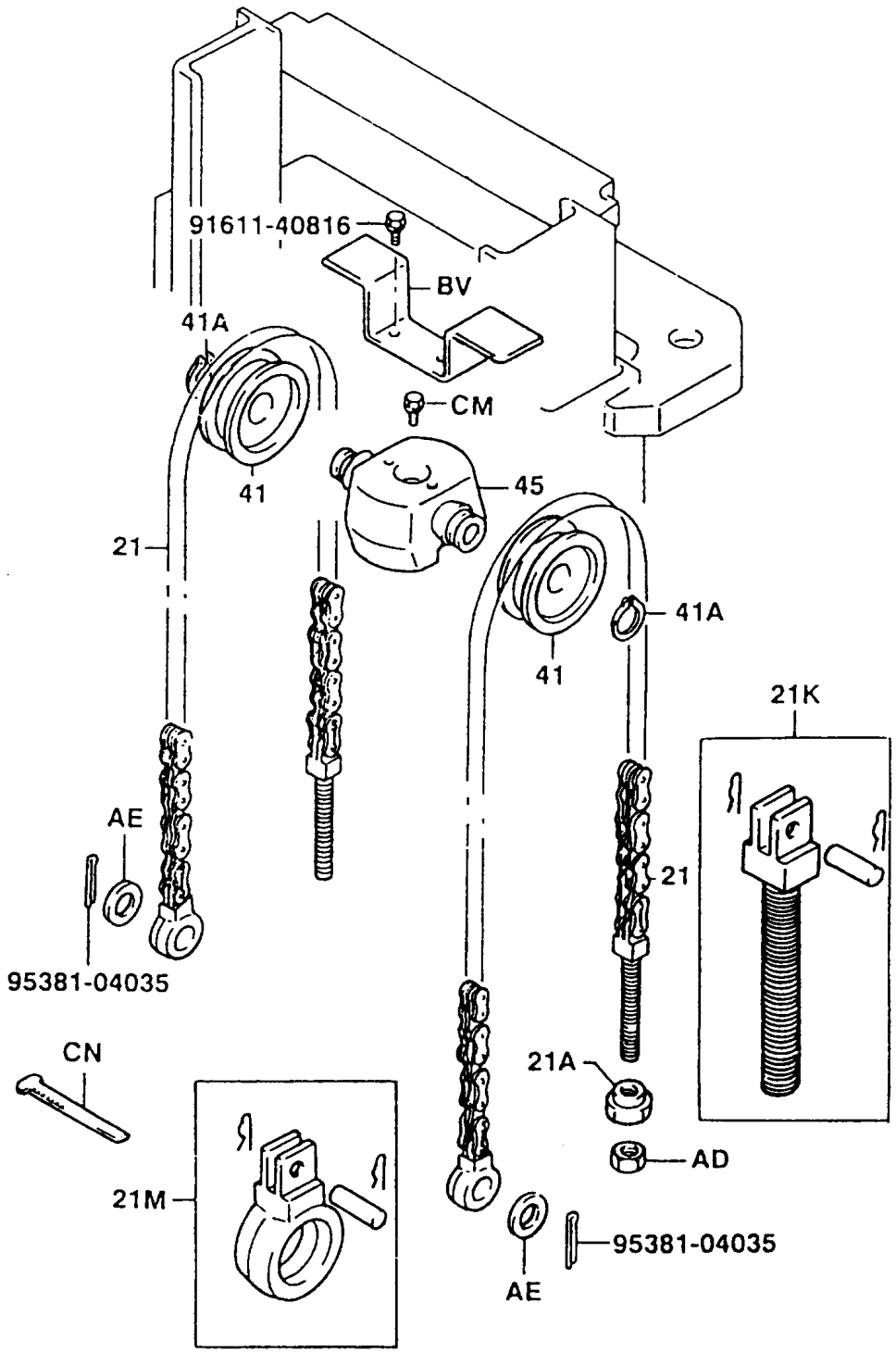
FV MAST ASSY

COMPONENTS

Refer to 15-3 for lift bracket components.



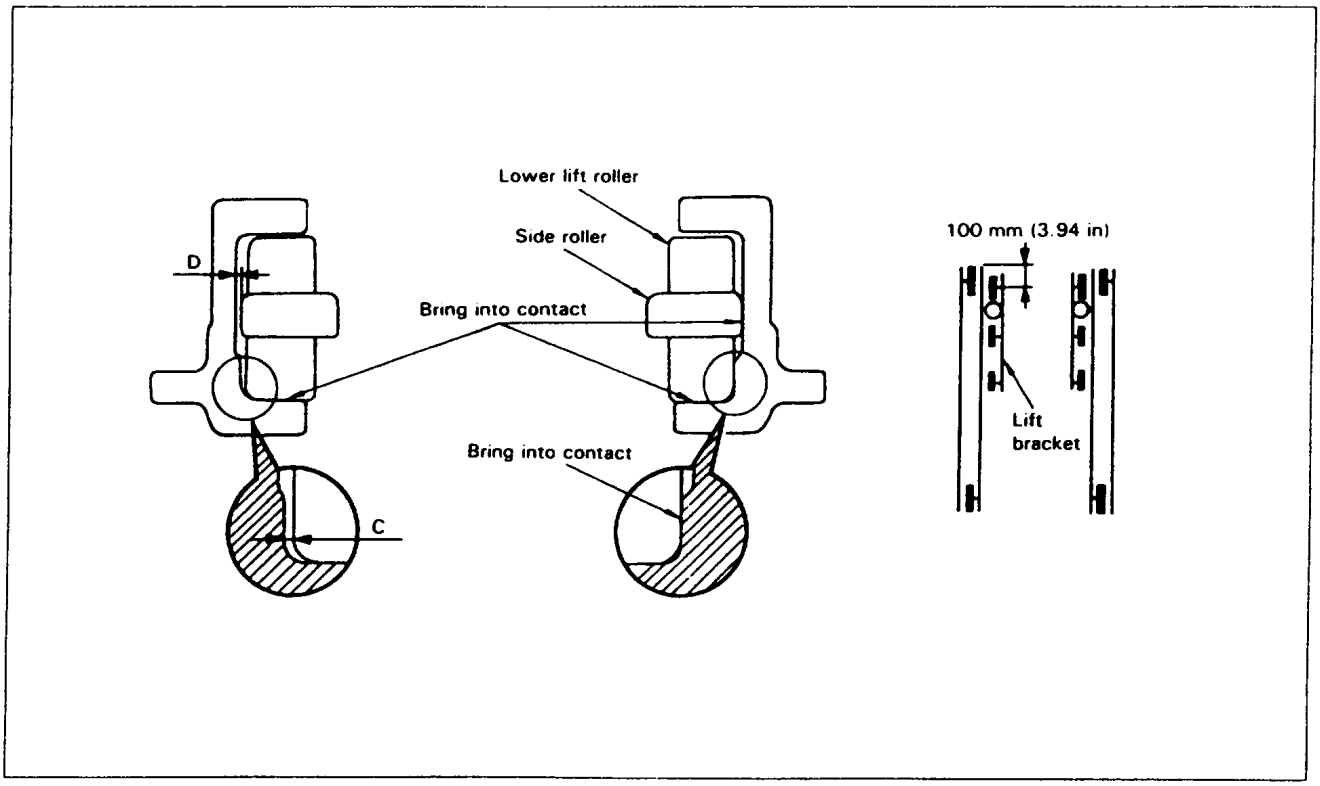
6302


91611-40816
BV
41A
CM
41
45
21
41A
41
21K
AE
21
95381-04035
CN
21A
AD
21M
95381-04035
AE
6302-302

MAST ADJUSTMENT

See the V mast adjustment procedure (on page 15-11) for the lift roller adjustment and mast strip adjustment (on page 15-16).

Lift Bracket Roller Adjustment (FV)



1. Lift roller and side roller clearance adjustment
   (1) Measure the clearance when the center of the lift bracket upper side roller is 100 mm (3.94 in) from the top of the inner mast.
   (2) The upper and middle lift rollers need no adjustment because they are fixed by snap rings.
   (3) For the lower lift roller, shift the lift bracket to one side to bring the roller into contact with the inner mast, and adjust the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

   Standard clearance C = 0 ~ 0.5 mm (0 ~ 0.020 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

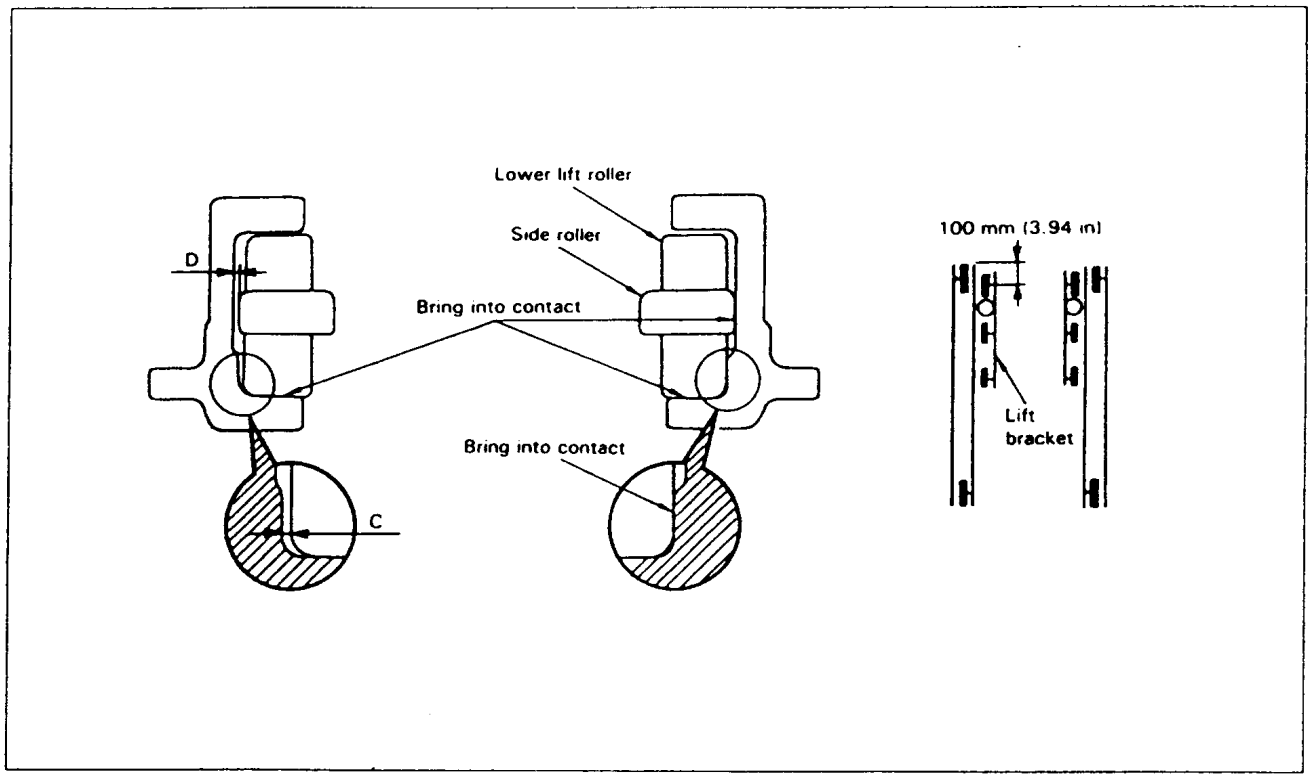
   (4) Distribute the shim thickness equally to the left and right sides.
   (5) Adjust the side rollers after adjusting the lower lift rollers. Bring the side roller on one side into contact with the mast side surface and adjust the clearance between the side roller and inner mast on the opposite side to the following value by inserting the side roller shim:

   Standard clearance D = 0 ~ 0.6 mm (0 ~ 0.024 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

   (6) Distribute the shim thickness equally to the left and right side rollers.

2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

Lift Bracket Roller Adjustment (FV)



1. Lift roller and side roller clearance adjustment
   (1) Measure the clearance when the center of the lift bracket upper side roller is 100 mm (3.94 in) from the top of the inner mast.
   (2) The upper and middle lift rollers need no adjustment because they are fixed by snap rings.
   (3) For the lower lift roller, shift the lift bracket to one side to bring the roller into contact with the inner mast, and adjust the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

   Standard clearance C = 0 ~ 0.5 mm (0 ~ 0.020 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

   (4) Distribute the shim thickness equally to the left and right sides.
   (5) Adjust the side rollers after adjusting the lower lift rollers. Bring the side roller on one side into contact with the mast side surface and adjust the clearance between the side roller and inner mast on the opposite side to the following value by inserting the side roller shim:

   Standard clearance D = 0 ~ 0.6 mm (0 ~ 0.024 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

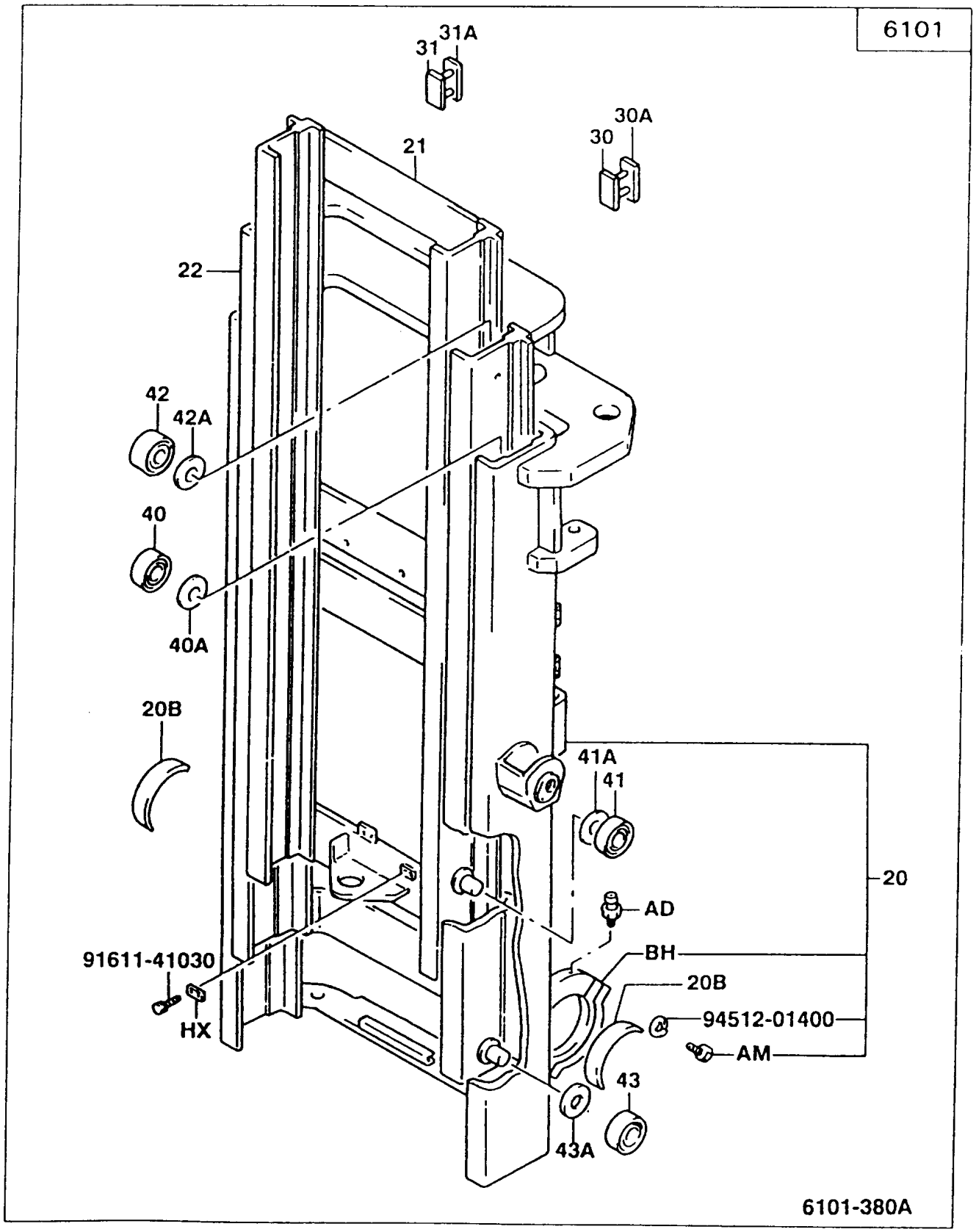
   (6) Distribute the shim thickness equally to the left and right side rollers.

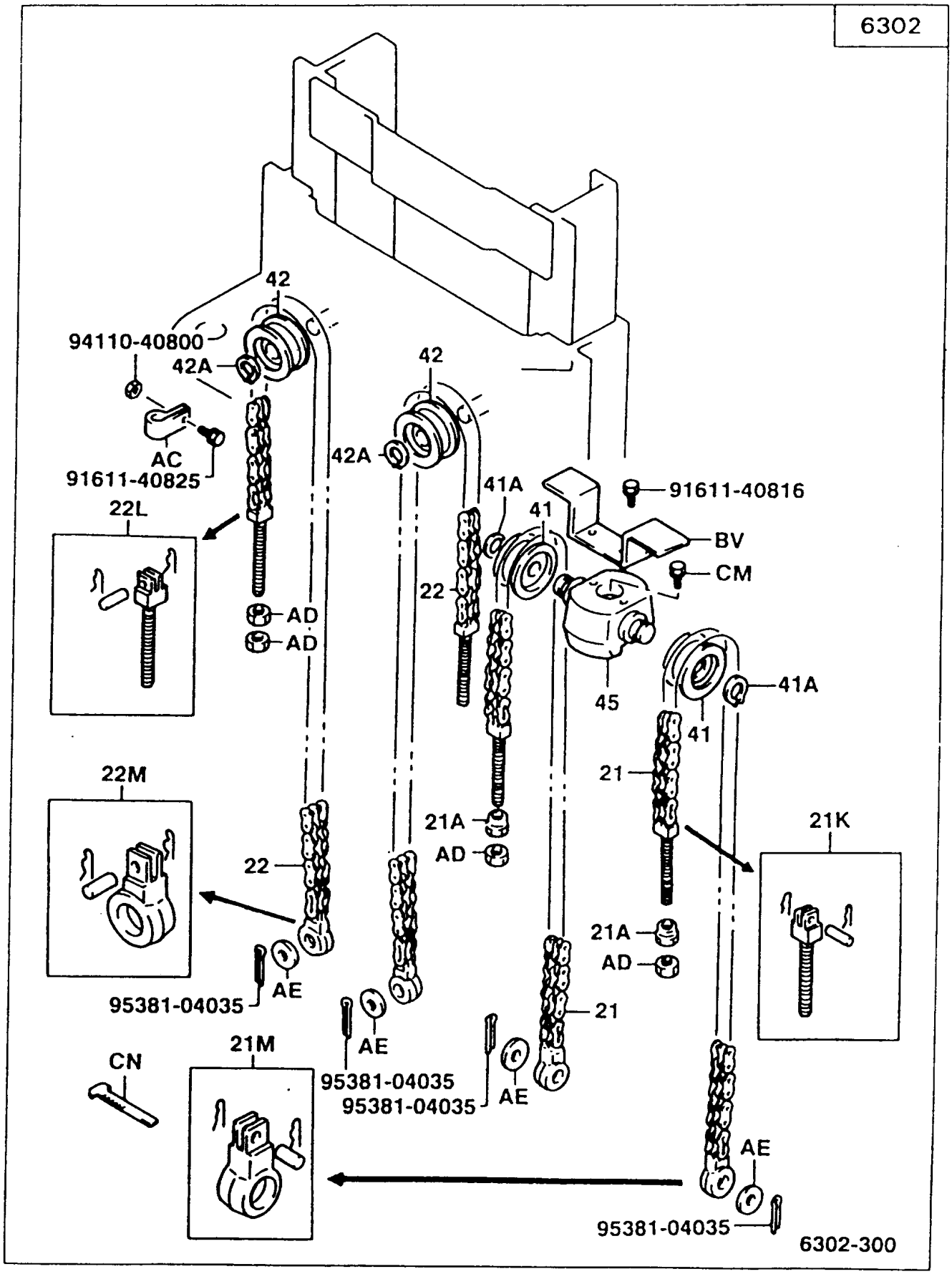
2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

FSV MAST ASSY

COMPONENTS

Refer to 15-3 for lift bracket components.




6302
42
94110-40800
42A
AC
91611-40825
22L
AD
AD
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42A
41A
41
91611-40816
BV
CM
22
45
41A
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22M
21A
AD
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21A
AD
95381-04035
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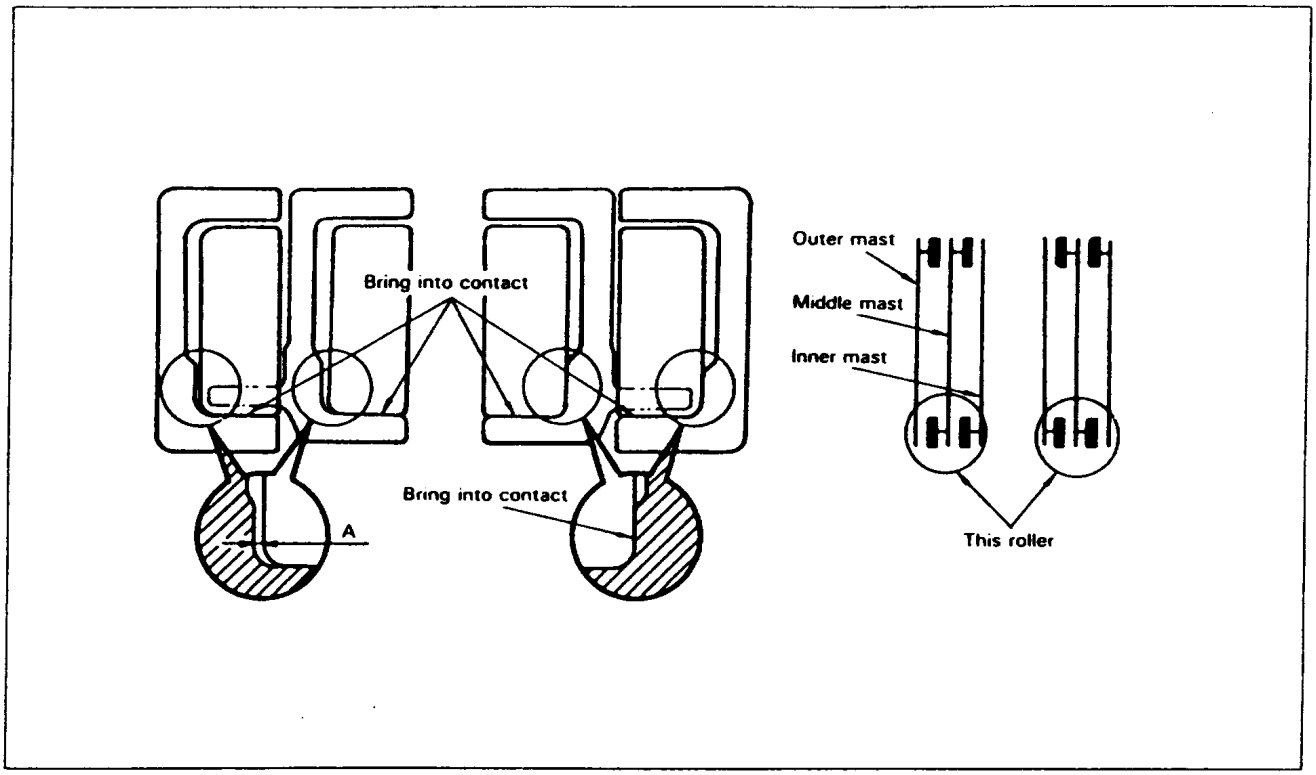
6302-300

MAST ADJUSTMENT

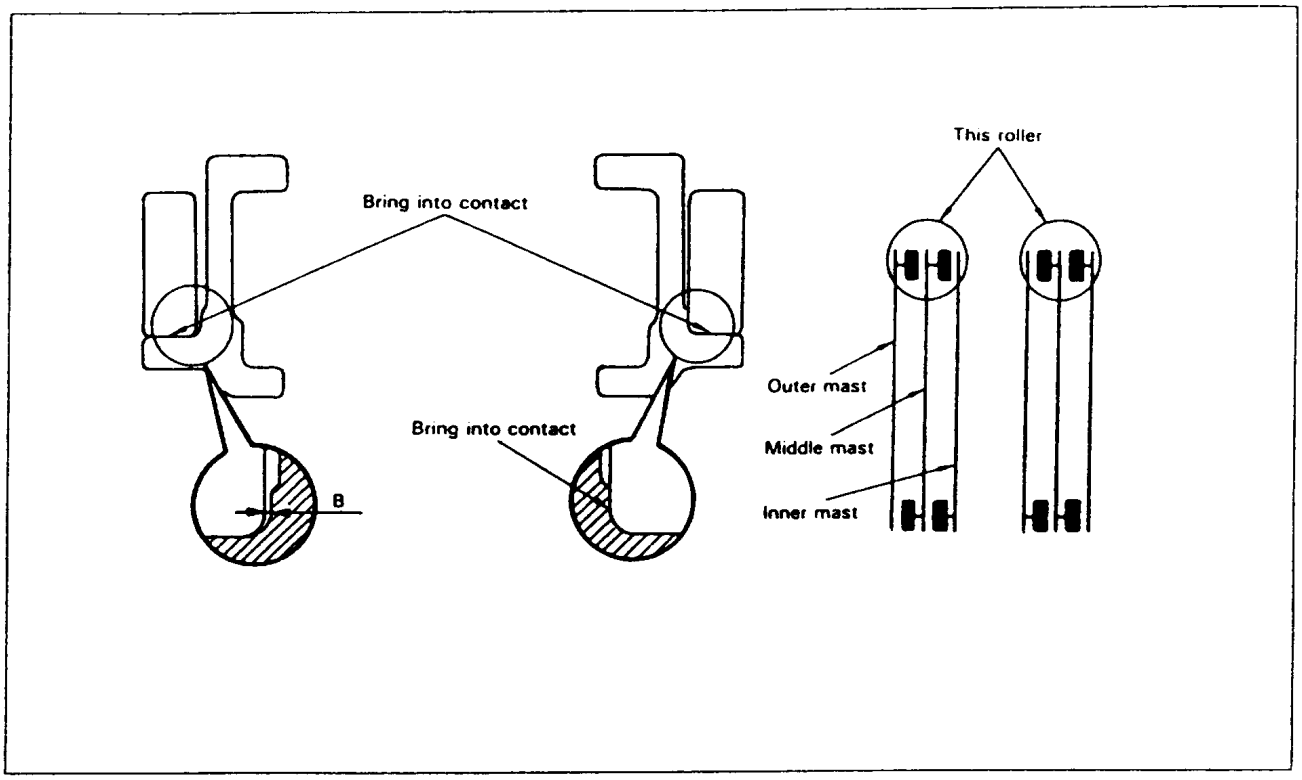
Mast Lift Roller Adjustment (FSV)



1. Inner mast roller and middle mast lower roller clearance adjustment
   (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
   (2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner mast roller shim and middle mast lower roller shim, respectively.

   Standard clearance A = 0 ~ 0.8 mm (0 ~ 0.031 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

   (3) Distribute the shim thickness equally to the left and right rollers.
   (4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

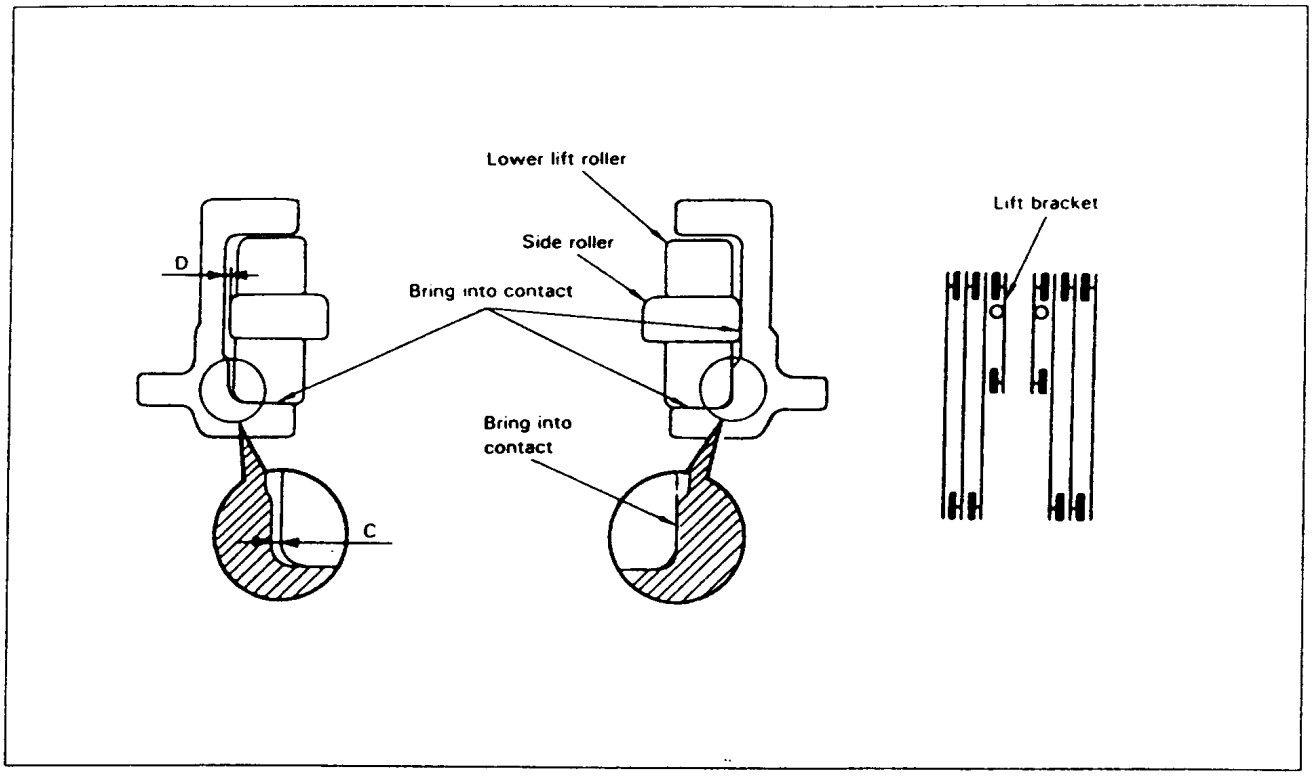


2. Outer mast roller and middle mast upper roller clearance adjustment
   (1) Measure the clearance with the mast overlap at near 450 mm (17.72 in).
   (2) Shift the inner mast to one side to bring the roller into contact with the inner mast and middle mast, and adjust the clearance between the roller and mast at the closest position on the opposite side to the following value by inserting the outer mast roller shim and middle mast upper roller shim respectively.

   Standard clearance B = 0 ~ 0.8 mm (0 ~ 0.031 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

   (3) Distribute the shim thickness equally to the left and right sides.
   (4) After the adjustment, check that the inner mast moves smoothly in the middle mast and the middle mast moves smoothly in the outer mast.

Lift Bracket Roller Adjustment (FSV)



1. Lift roller and side roller clearance adjustment
   (1) Measure the clearance with the lift bracket at the uppermost position.
   (2) The upper lift rollers need no adjustment because they are fixed by snap rings.
   (3) For the lower lift rollers, shift the lift bracket to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and the mast at the closest position on the opposite side to the following value by inserting the lift roller shim.

   Standard clearance C = 0 ~ 0.5 mm (0 ~ 0.020 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 and 0.039 in)

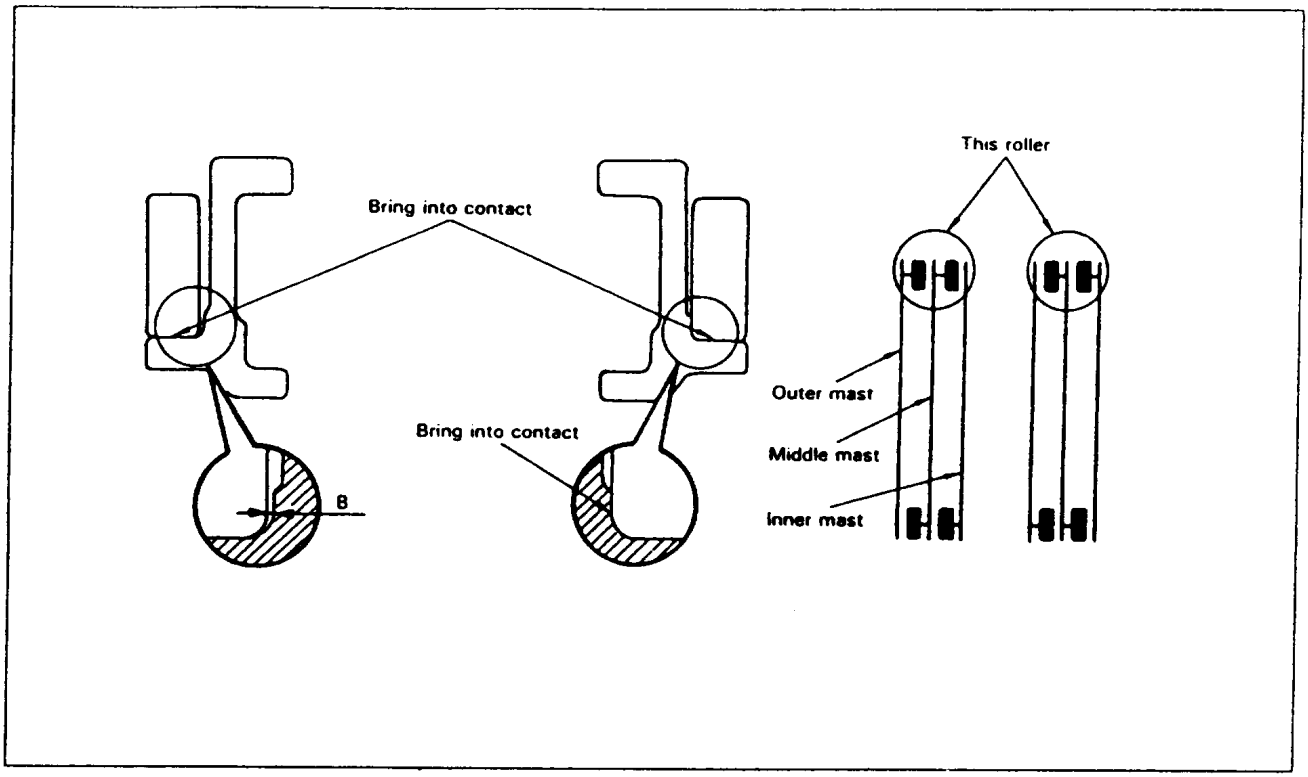
   (4) Distribute the shim thickness equally to the left and right rollers.
   (5) Adjust the side rollers after adjusting the lower lift rollers.
   Bring the side roller on one side into contact with the mast side surface, and adjust the clearance between the side roller and inner mast side surface to the following value by inserting the side roller shim:

   Standard clearance D = 0 ~ 0.6 mm (0 ~ 0.024 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 ~ 0.039 in)

   (6) Distribute the shim thickness equally to the left and right sides.

2. After the adjustment, the lift bracket should move smoothly along the overall mast length.

Mast Strip Adjustment (FSV)



1. Mast strip clearance adjustment
   (1) Measure the clearance with the inner mast or middle mast at the bottom position.
   (2) With the inner mast in contact with the middle mast upper roller, adjust the clearance between the mast strip and inner mast to the value shown below by inserting the mast strip shim. Then, with the middle mast in contact with the outer mast roller, adjust the clearance between the mast strip and the middle mast to the value shown below by inserting the mast strip shim.

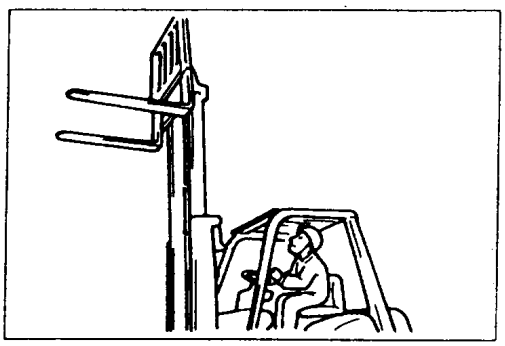
   Standard clearance E = 0.5 ~ 1.0 mm (0.020 ~ 0.039 in)
   Shim thickness: 0.5 and 1.0 mm (0.020 ~ 0.039 in)

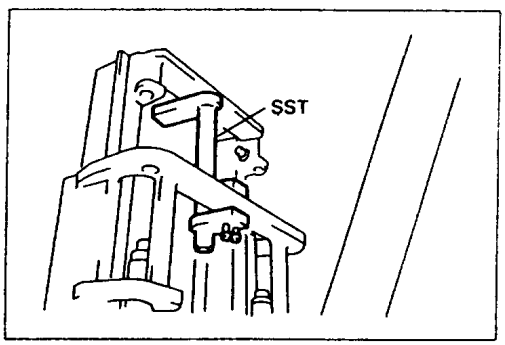
   (3) After the adjustment, the mast should move smoothly.

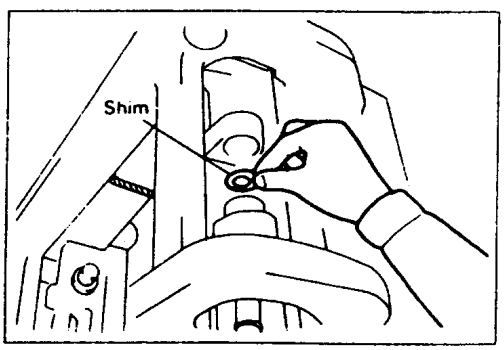
LIFT CYLINDER ROD SHIM ADJUSTMENT (PREVENTION OF UNEVEN LIFTING)

Note:

- **For double lift cylinders, inspection and adjustment are required to prevent uneven lifting on the left and right sides due to tolerances of parts, etc.**
- **The inspection and adjustments must be made whenever any of the following parts is replaced: Lift cylinder ASSY, lift cylinder rod SUB-ASSY, lift cylinder SUB-ASSY, mast ASSY, outer mast SUB-ASSY, and inner mast SUB-ASSY**







1. Inspection method
   Slowly raise the inner mast, and observe the stopping states of the left and right cylinder rods at the moment when the inner mast reaches the maximum height.
   (1) Normal case
   Both the left and right rods stop almost simultaneously with almost no shaking of the inner mast.
   (2) Abnormal case
   The rods stop with slight difference and the top of the inner mast shakes at the time of stopping. To correct this, add shims to the cylinder that stops first.

2. Adjustment method
   (1) Raise the inner mast, set the SST to the outer mast tie beam, and lower the inner mast until it reaches the SST.
   SST 09610-22000-71
   (2) Remove the set bolt of the cylinder rod end on the side requiring shim adjustment.
   (3) Slowly lower the lift cylinder rod and disconnect the cylinder rod end.
   (4) Place shims on the cylinder rod end. Slowly raise the cylinder rod end into the inner mast.
   (5) Fix the set bolt of the cylinder rod end.
   (6) Raise the inner mast for reinspection.
   (7) Repeat the inspection and adjustment until the number of shims is determined.

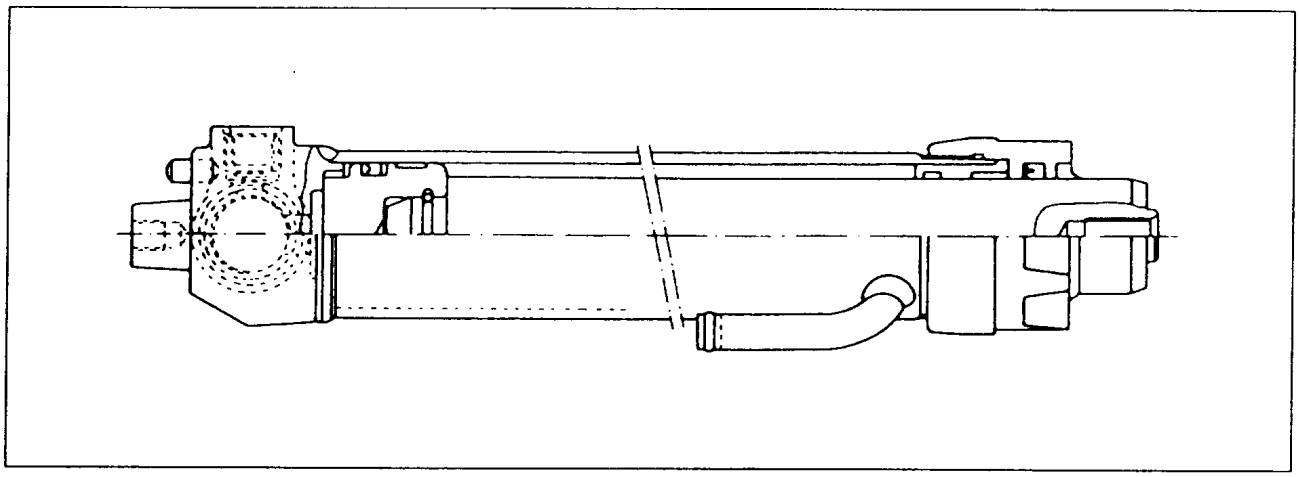
   Shim thickness:
   0.5 and 1.0 mm (0.020 and 0.039 in)

CYLINDER

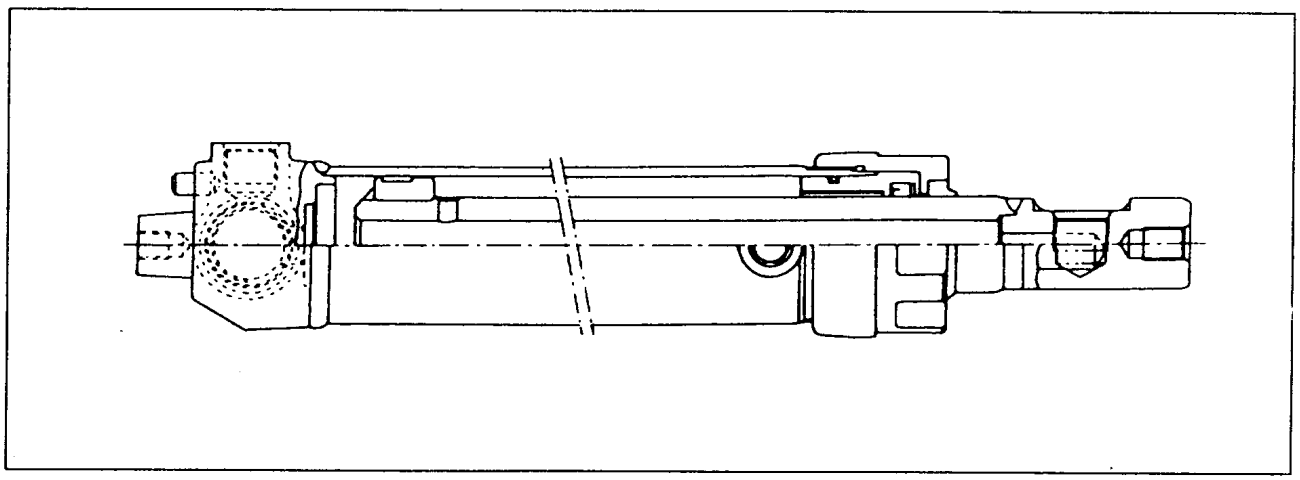
LIFT CYLINDER (V)·REAR LIFT CYLINDER (FV·FSV)

GENERAL

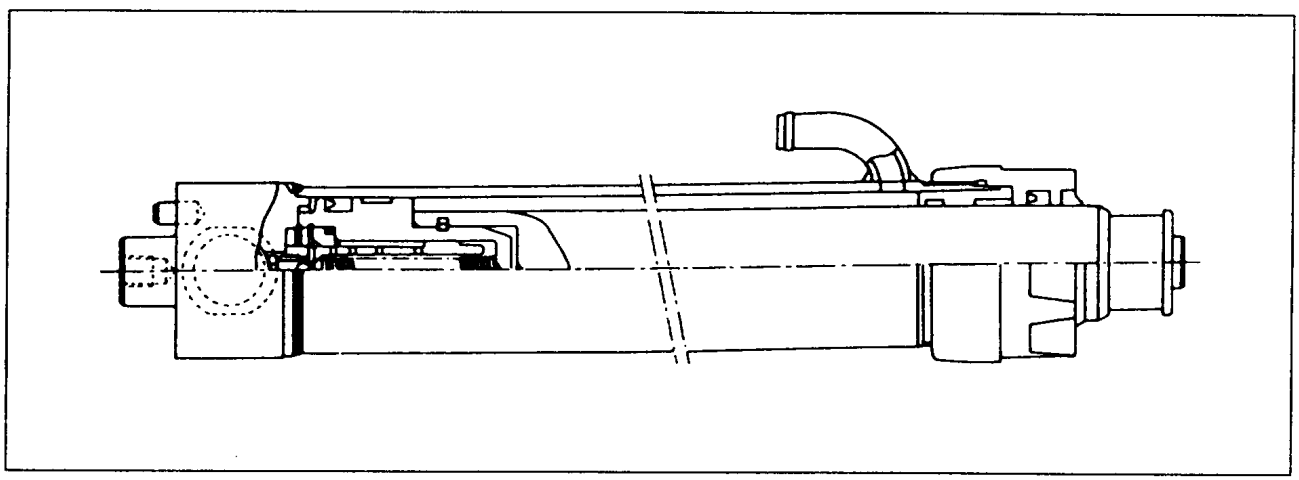
Lift Cylinder (V)



Rear Lift Cylinder (FV)



Rear Lift Cylinder (FSV)



SPECIFICATIONS

Lift Cylinder (V)

Item \ Model	FBMF16	FBMF20·25	FBMF30
Lift cylinder type	Single acting	←	←
Lift cylinder bore mm (in)	45 (1.77)	50 (1.97)	55 (2.17)
Lift cylinder rod outside diameter mm (in)	35 (1.38)	40 (1.57)	45 (1.77)
Piston seal type	U packing	←	←
Rod seal type	U packing	←	←
Others	With flow regulator valve (RH) With safety down valve (LH)	←	←

Rear Lift Cylinder (FV)

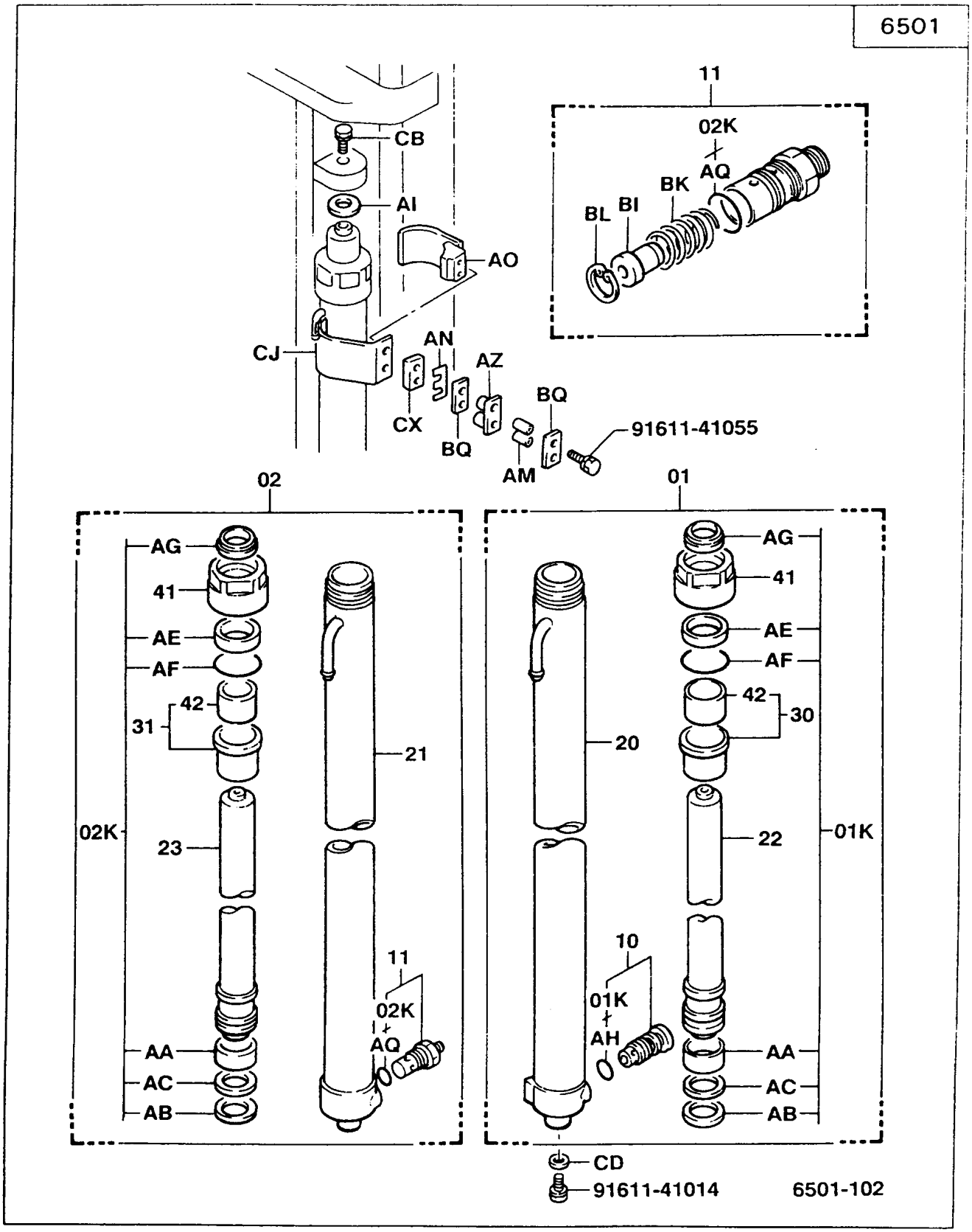
Item \ Model	FBMF16	FBMF20·25	FBMF30
Lift cylinder type	Single acting	←	←
Lift cylinder bore mm (in)	45 (1.77)	50 (1.97)	55 (2.17)
Cylinder rod outside diameter mm (in)	32 (1.26)	35 (1.38)	40 (1.57)
Rod seal type	U packing	←	←
Others	With flow regulator valve (RH) With safety down valve (LH)	←	←

Rear Lift Cylinder (FSV)

Item \ Model	FBMF16	FBMF20·25	FBMF30
Lift cylinder type	Single acting	←	←
Lift cylinder bore mm (in)	45 (1.77)	50 (1.97)	55 (2.17)
Cylinder rod outside diameter mm (in)	35 (1.38)	40 (1.57)	45 (1.77)
Piston seal type	U packing	←	←
Rod seal type	U packing	←	←
Others	With safety down valve (RH)	←	←

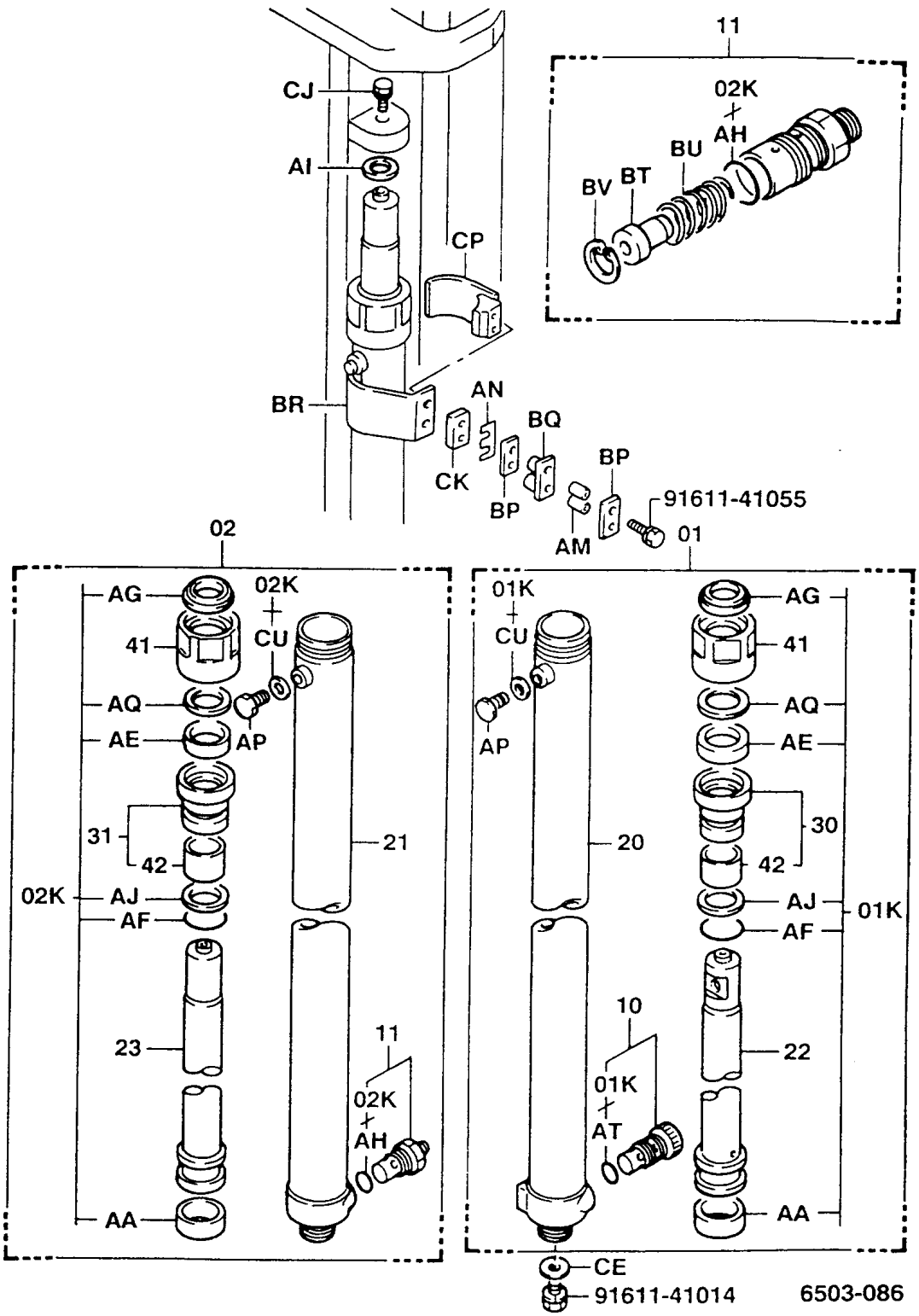
COMPONENTS

Lift Cylinder (V)



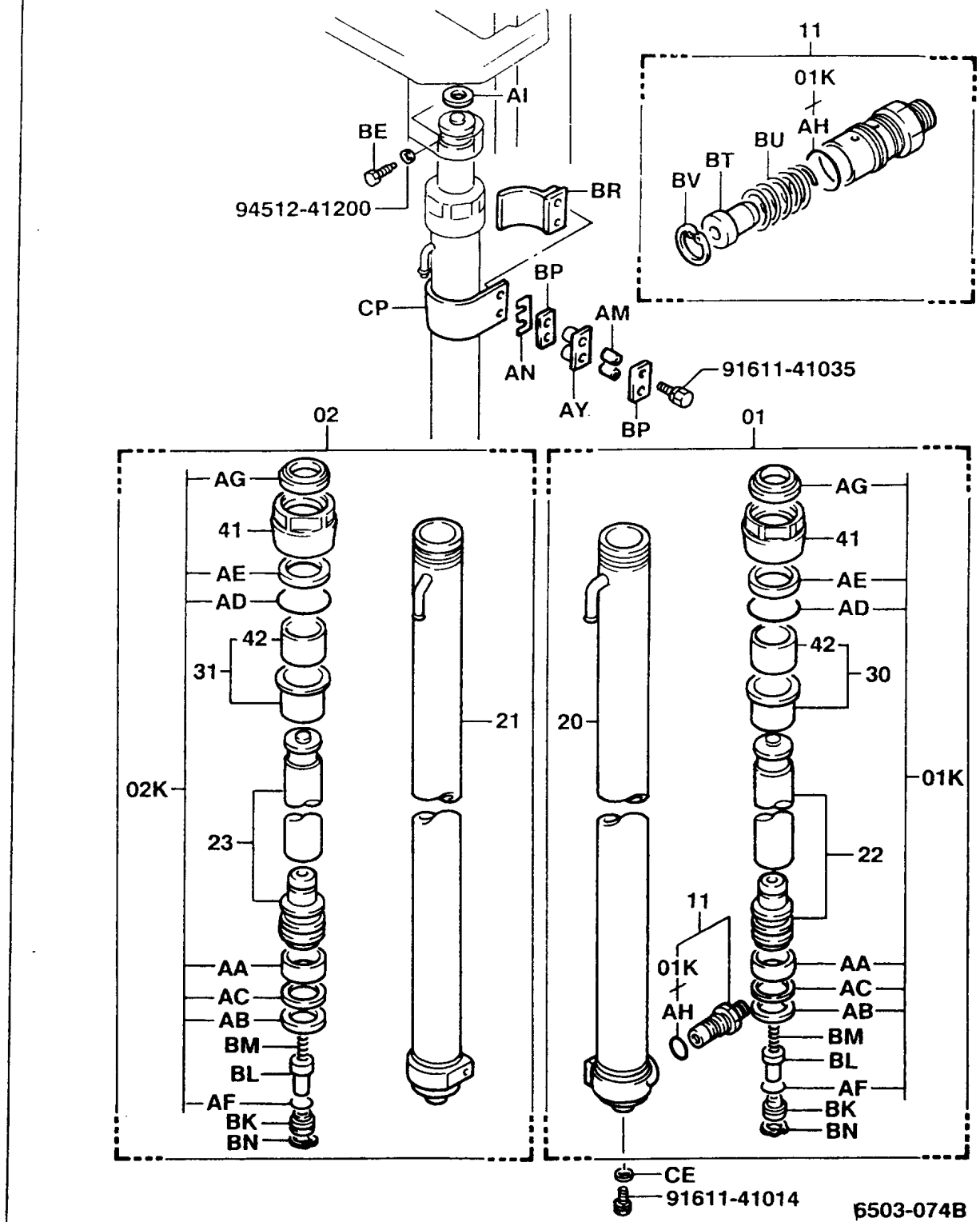
Rear Lift Cylinder (FV)

6503

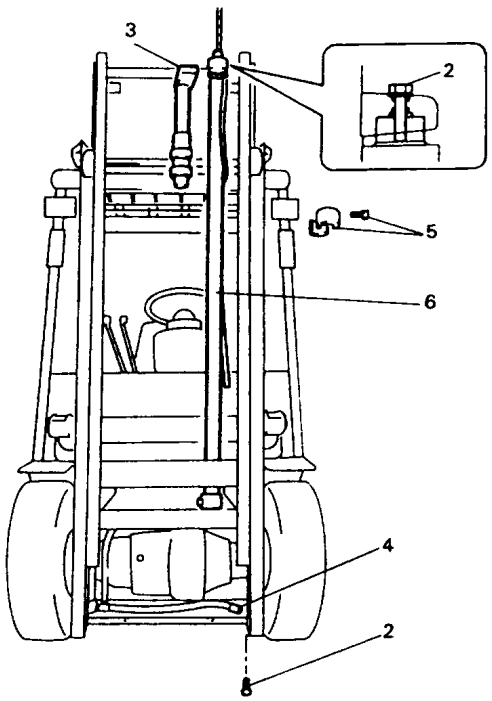


Rear Lift Cylinder (FSV)

6503



REMOVAL·INSTALLATION



1 Lift bracket

Removal Procedure

1 Remove the lift bracket. (See removal procedure steps 1 to 4 in mast removal-installation section on page 15-5.)

2 Remove the cylinder rod end set bolt and cylinder bottom set bolt.

3 Disconnect the cylinder rod end. **[Point 1]**

4 Disconnect the hose.

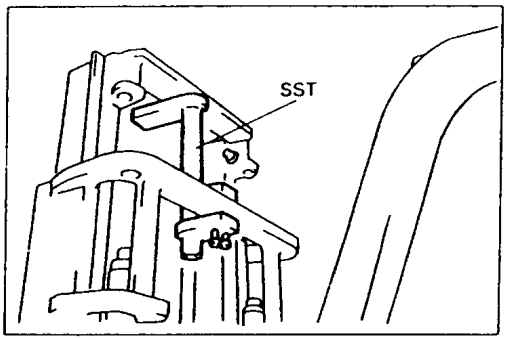
5 Remove the lift cylinder support. **[Point 2]**

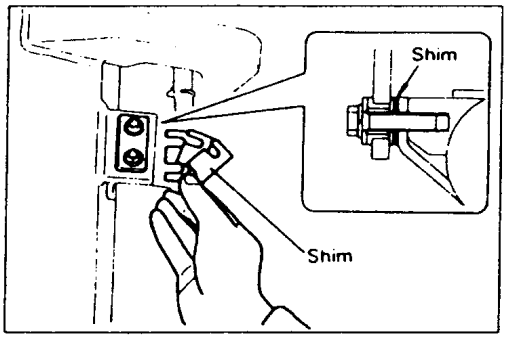
6 Remove the lift cylinder ASSY.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
Perform the following operations after installing the lift cylinder:
- **Repeat lifting and lowering to stroke ends without load to bleed the air and to check normal operation.**
- **After the operation check, check the hydraulic oil level and add oil if insufficient.**
- **Inspect the lift cylinders for uneven movement and make adjustment if necessary. (See the lift cylinder rod shim adjustment section on page 15-29.)**





Point Operations

[Point 1]

Removal: Hoist the inner mast (middle mast) and set the SST to the inner mast (middle mast) tie beam.
SST 09610-22000-71

Removal: Shim adjustment is made at the lift cylinder rod end to prevent uneven movement of the lift cylinders RH and LH. Take a note on which side the adjustment is made and the number of shims used.

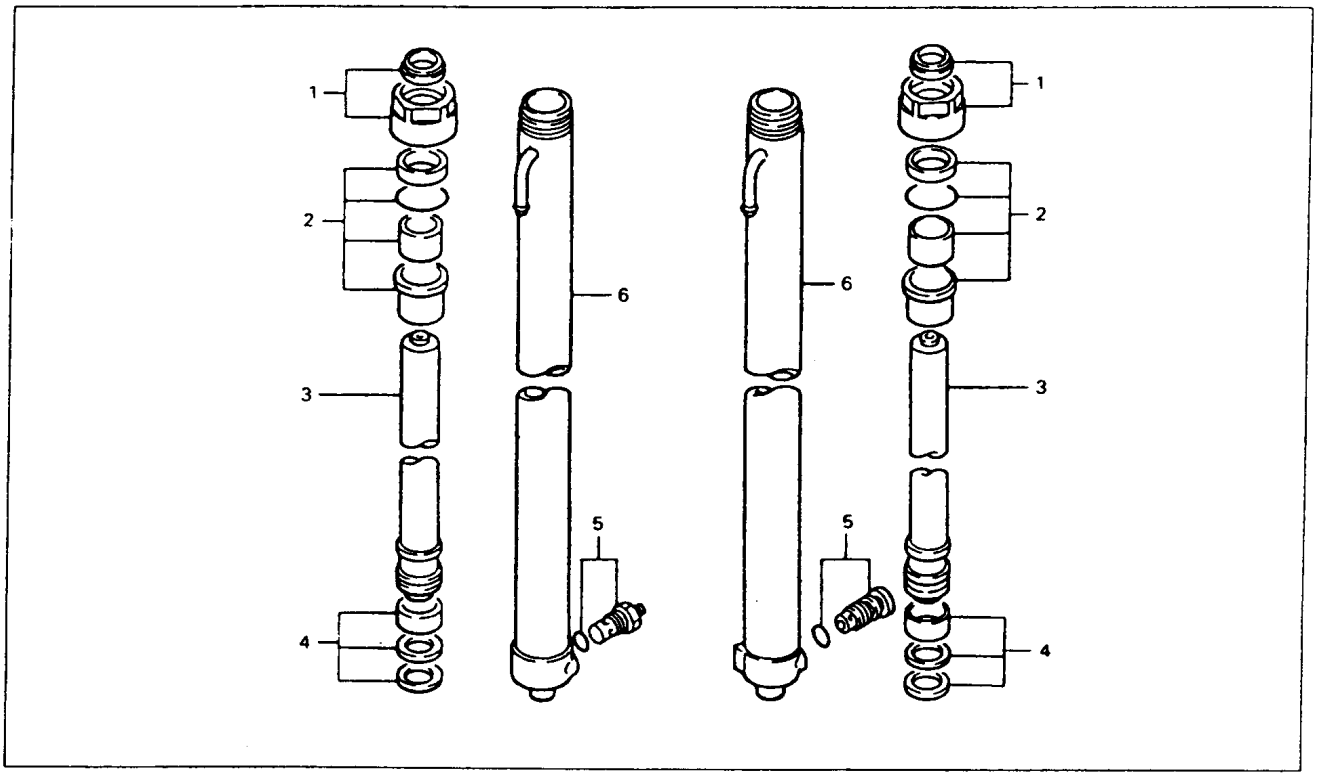
[Point 2]

Installation: The cylinder support shall be tightened temporarily here and make shim adjustment after rod end connection.

Adjustment: With the rod end connected, insert shims between the cylinder support and outer mast to eliminate the clearance. The shim thickness shall be slightly on the thicker side.

DISASSEMBLY·INSPECTION·REASSEMBLY

Note:
- **Oil will leak if the U packing or dust seal at the rod guide portion is defective.**
- **Natural drop will occur if the U packing at the piston portion is defective.**



Disassembly Procedure

1 Remove the cylinder cover.

2 Remove the rod guide.

3 Remove the piston rod. **[Point 1]**

4 Remove seals from the piston side.

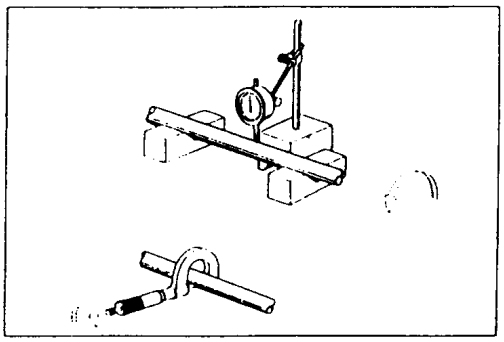
5 Remove the flow regulator valve or safety down valve.

6 Remove the lift cylinder. **[Point 2]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
- **Do not install dry parts but apply hydraulic oil before reassembly.**
- **Apply sealant 08833-76002-71 (08833-00080) on the threaded portion of the cylinder cover before tightening.**
- **Cylinder cover tightening torque T = 343.23 ~ 441.30 N·m (3500 ~ 4500 kgf-cm) [253.23 ~ 325.58 ft-lbf]**



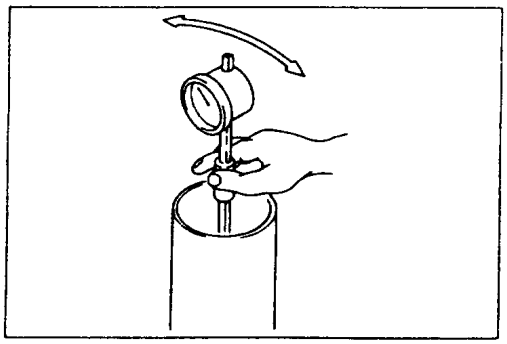
Point Operations

[Point 1]

Inspection: Measure the piston rod outside diameter.

Unit: mm (in)

Mast	Model	Standard outside diameter	Limit outside diameter
V FSV	FBMF16	35 (1.38)	34.92 (1.3748)
	FBMF20·25	40 (1.57)	39.92 (1.5717)
	FBMF30	45 (1.77)	44.92 (1.7685)
FV	FBMF16	32 (1.26)	31.92 (1.2567)
	FBMF20·25	35 (1.38)	34.92 (1.3748)
	FBMF30	40 (1.57)	39.92 (1.5717)



Inspection: Measure the piston rod bend.

Limit bend: 2.0 mm (0.079 in)

[Point 2]

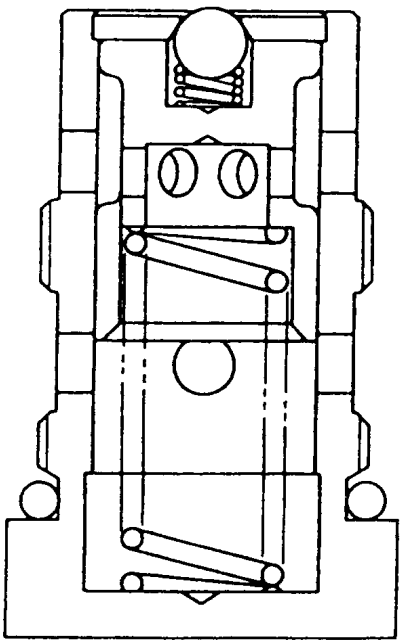
Inspection: Measure the lift cylinder bore.

Unit: mm (in)

Model	Standard bore	Limit bore
FBMF16	45 (1.77)	45.20 (1.7795)
FBMF20·25	50 (1.97)	50.20 (1.9764)
FBMF30	55 (2.17)	55.35 (2.1791)

FLOW REGULATOR VALVE (V·FV·FSV)

GENERAL



SPECIFICATIONS

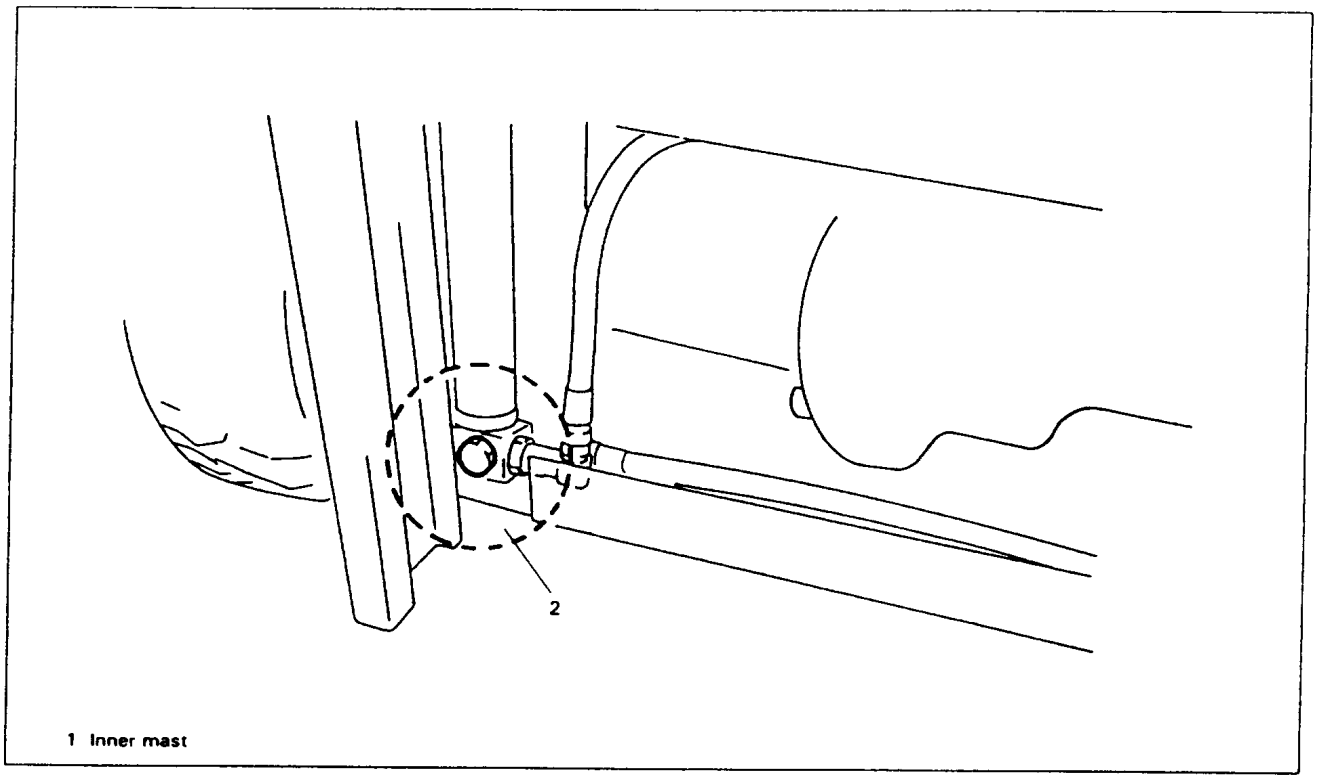
Lowering speed

Unit: mm/sec (fpm)

Model \ Mast		V	FV	FSV
FBMF16	Non loaded	550 (108)	420 (83)	450 (89)
	Loaded	500 (98)	480 (94)	480 (94)
FBMF20·25	Non loaded	500 (98)	420 (83)	450 (89)
	Loaded	500 (98)	480 (94)	480 (94)
FBMF30	Non loaded	500 (98)	390 (77)	420 (83)
	Loaded	500 (98)	460 (91)	460 (91)

REMOVAL·INSTALLATION

Note:
- **The description here is for the flow regulator valve for the V or FV mast.**
- **The flow regulator valve is installed on the outer mast side in case of the FSV mast.**



Removal Procedure

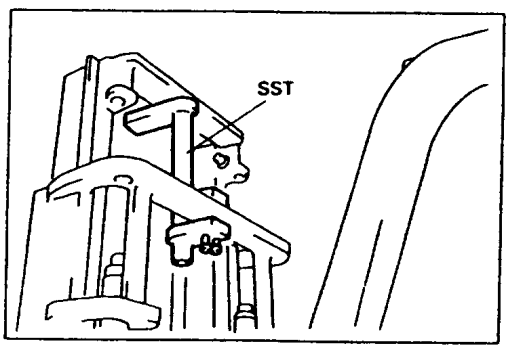
1 Hoist the inner mast. **[Point 1]**

2 Remove the flow regulator valve.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
Flow regulator valve tightening torque
T = 58.84 ~ 68.65 N·m (600 ~ 700 kgf-cm) [43.41 ~ 50.65 ft-lbf]



Point Operation

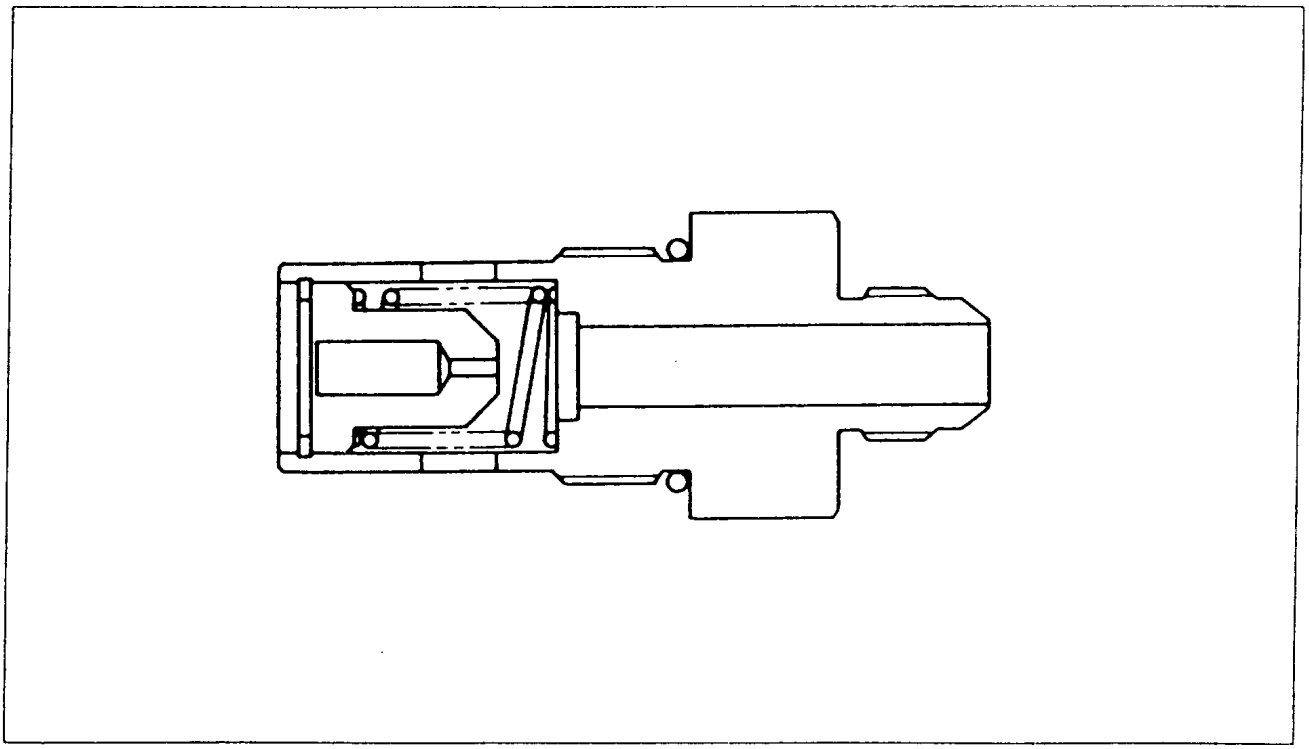
[Point 1]

Removal·installation: Sling the inner mast (middle mast) with a wire rope and hoist it. Set the SST on the inner mast (middle mast) tie beam and lower the inner mast until it comes into contact with the SST.
SST 09610-22000-71

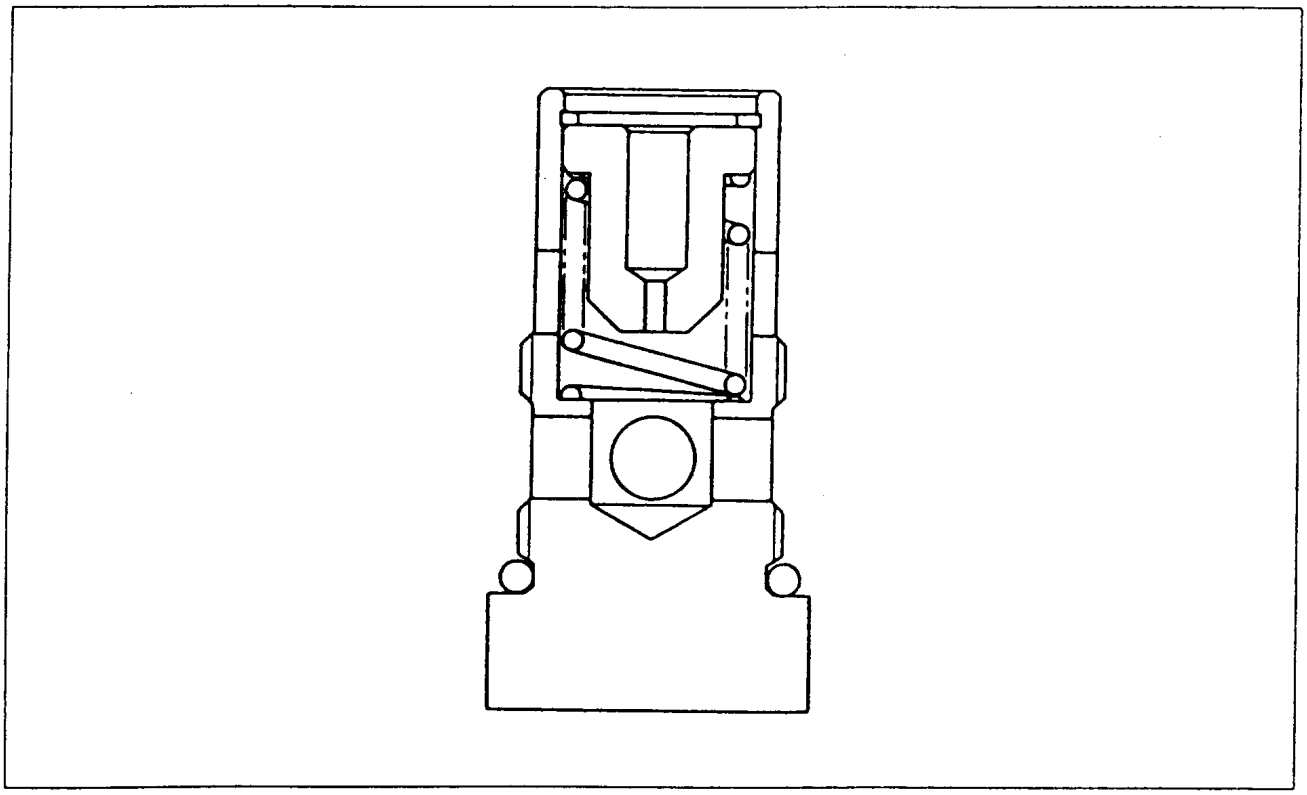
SAFETY DOWN VALVE (V·FV·FSV)

GENERAL

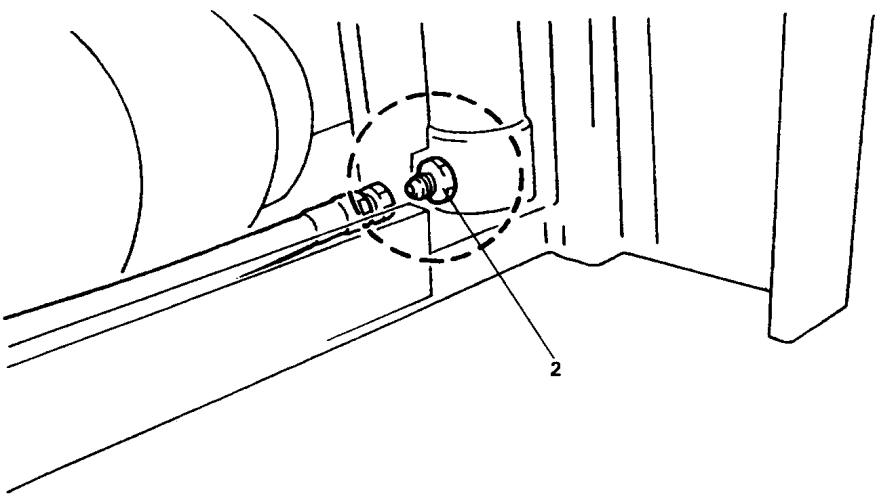
Safety Down Valve Sectional View (for V) (for FV·FSV Rear Lift Cylinder)



Safety Down Valve Sectional View (for FV·FSV Front Lift Cylinder)



REMOVAL·INSTALLATION



1 Inner mast

Removal Procedure

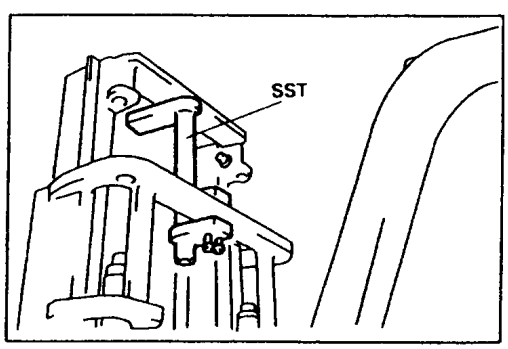
1 Hoist the inner mast. **[Point 1]**

2 Remove the safety down valve.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
Safety down valve tightening torque
T = 29.42 ~ 39.23 N·m (300 ~ 400 kgf-cm) [21.71 ~ 28.94 ft-lbf]



Point Operation

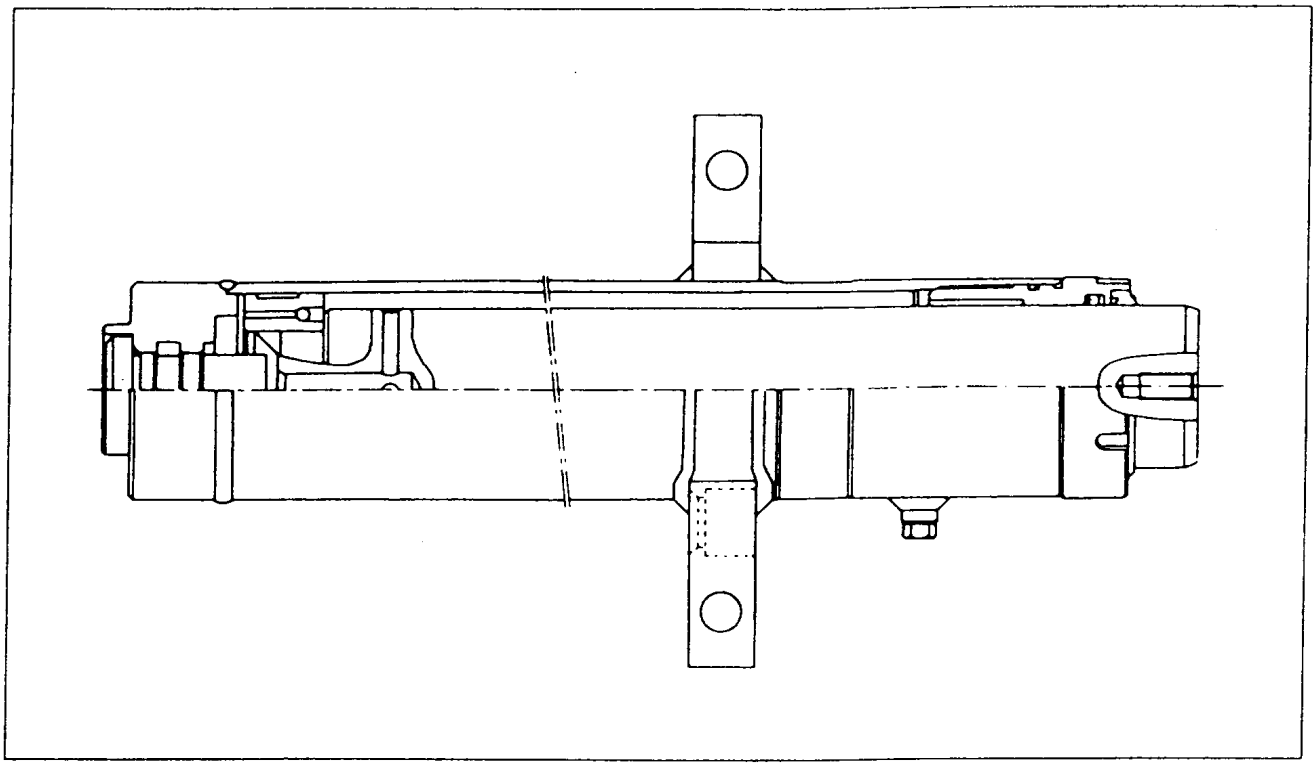
[Point 1]

Removal·installation: Sling the inner mast (middle mast) with a wire rope, and hoist it. Set the SST on the inner mast (middle mast) tie beam and lower the inner mast until it comes into contact with the SST.
SST 09610-22000-71

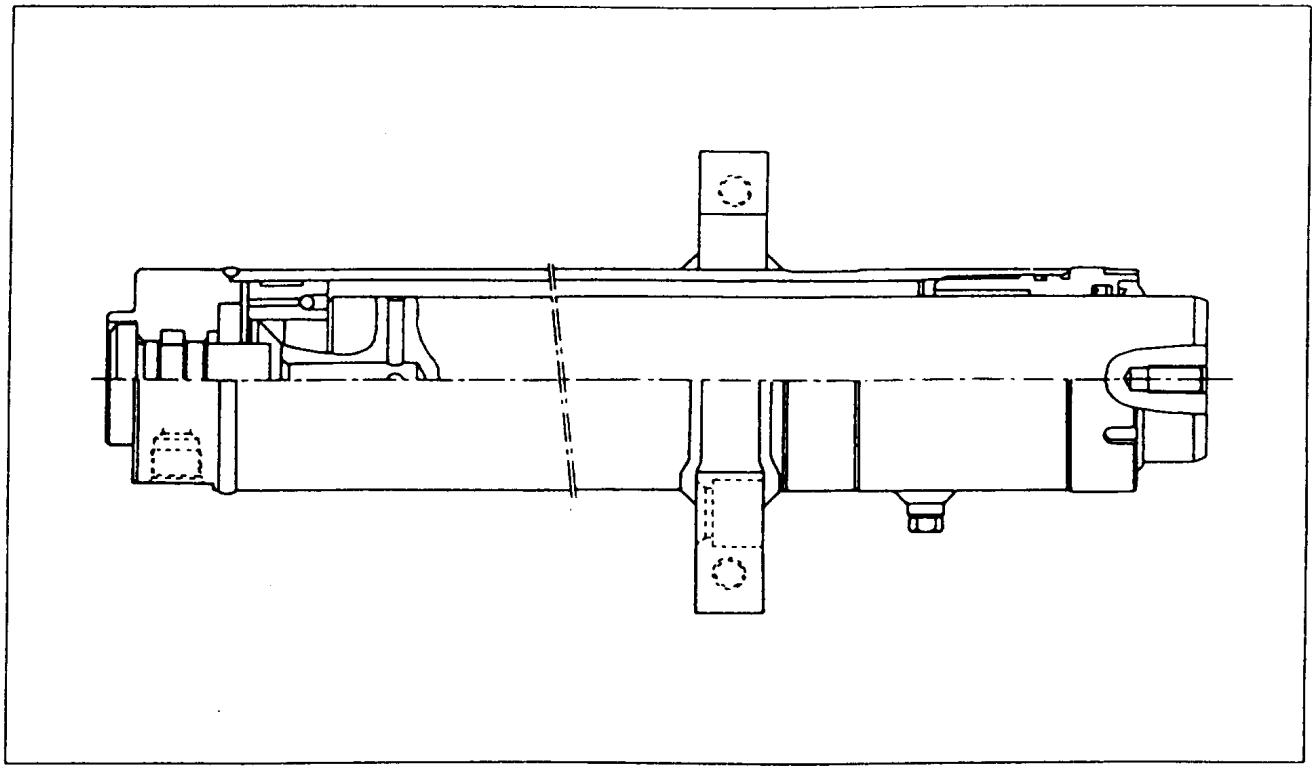
FRONT LIFT CYLINDER (FV·FSV)

GENERAL

Front Lift Cylinder (FV)



Front Lift Cylinder (FSV)

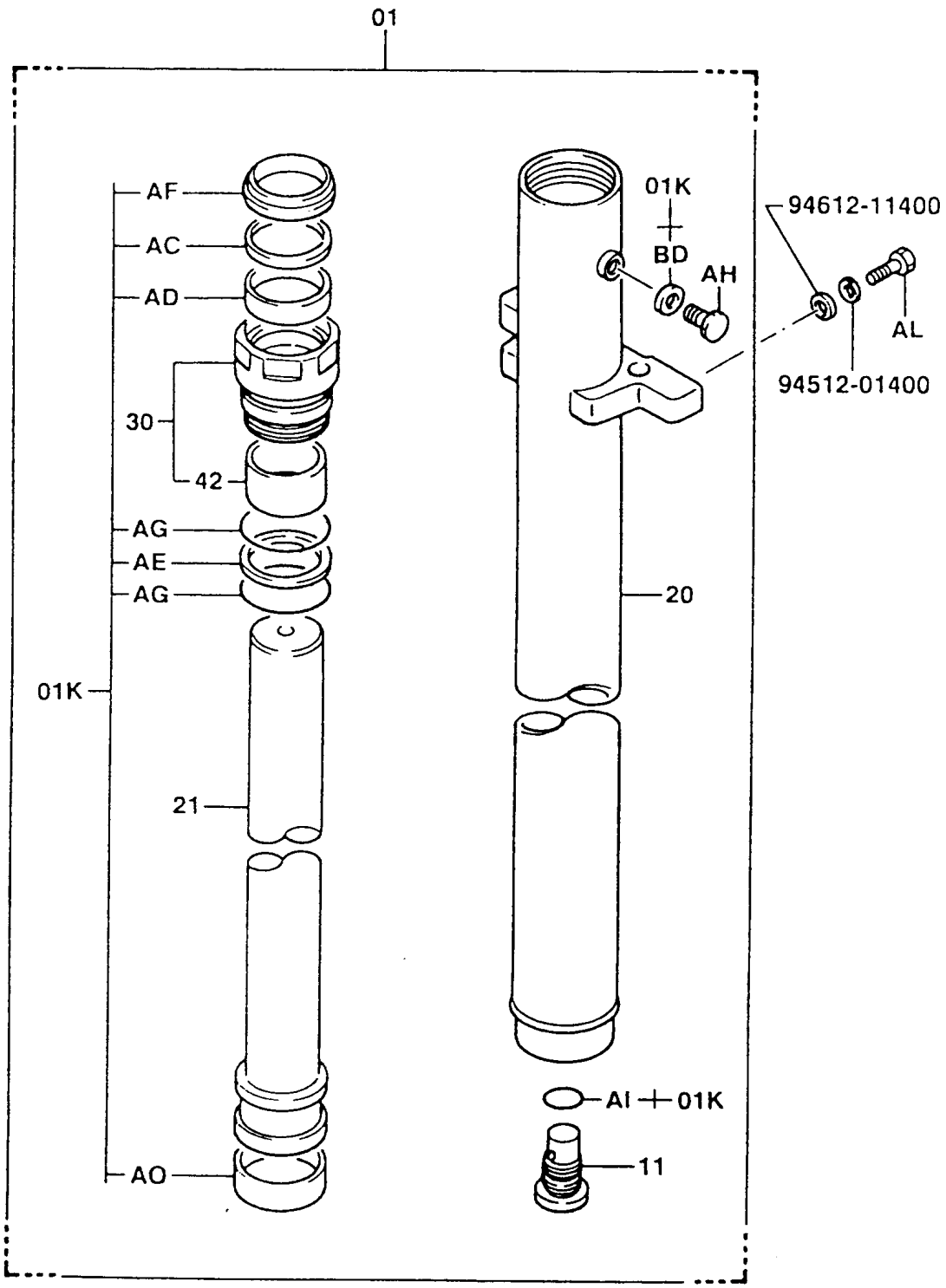


SPECIFICATIONS

Item \ Model	FBMF16	FBMF20·25	FBMF30
Cylinder type	Single acting	←	←
Lift cylinder bore mm (in)	85 (3.35)	90 (3.54)	105 (4.13)
Cylinder rod outside diameter mm (in)	70 (2.76)	75 (2.95)	85 (3.35)
Piston seal type	Wear ring	←	←
Rod seal type	U packing	←	←
Others	With safety down valve	←	←

COMPONENTS

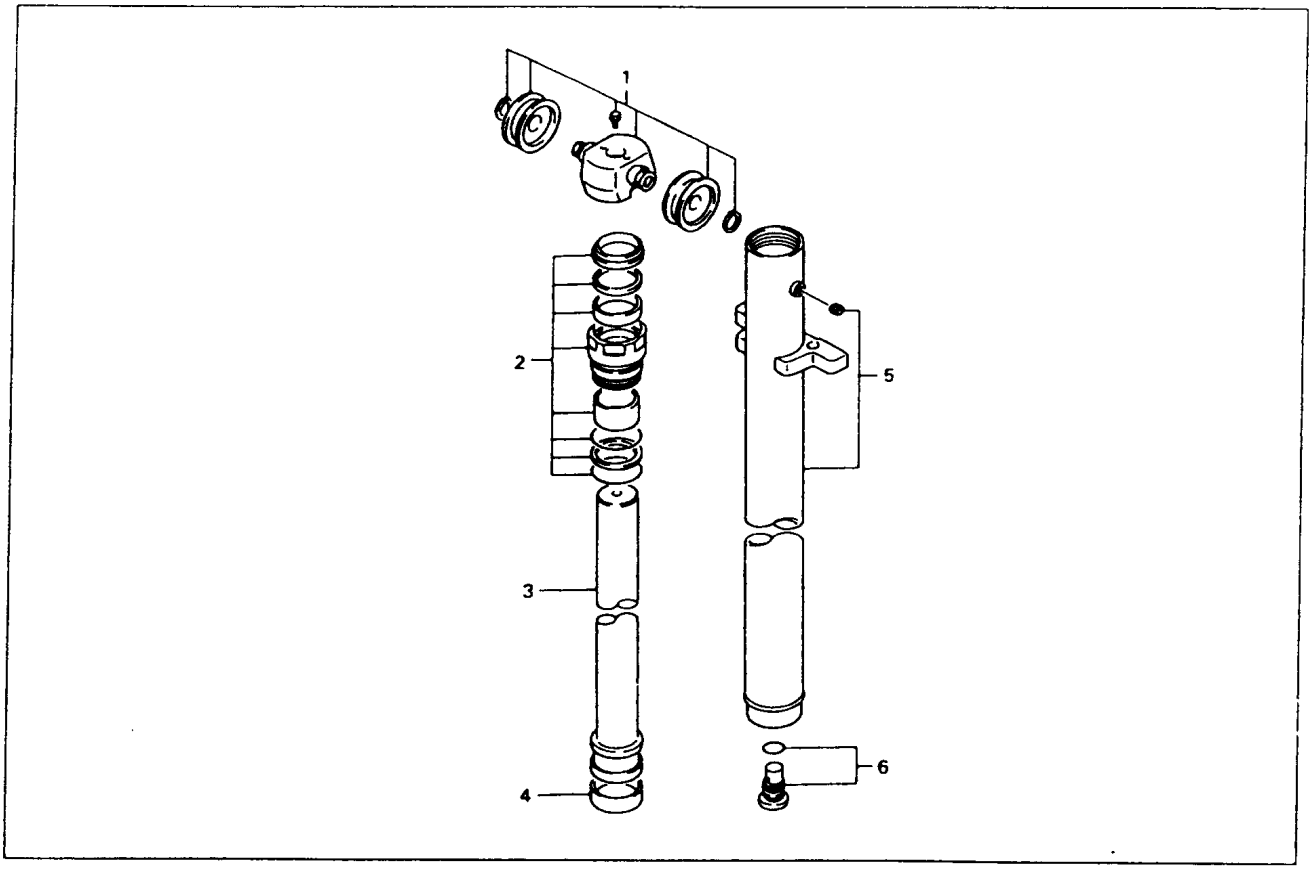
6502



REMOVAL·INSTALLATION

Note:
- See the lift cylinder ASSY (V) removal section for the removal of the front lift cylinder ASSY. Perform the following operations after installation:
- Repeat lifting and lowering to stroke ends without load for air bleeding and check normal operation.
- After the operation check, check the hydraulic oil level and add if insufficient.
- Adjust the lift chain tension equally on the left and right sides.

DISASSEMBLY·INSPECTION·REASSEMBLY



Disassembly Procedure

1 Remove the chain wheel supporter.

2 Remove the cylinder rod guide.

3 Remove the piston rod. **[Point 1]**

4 Remove the wear ring.

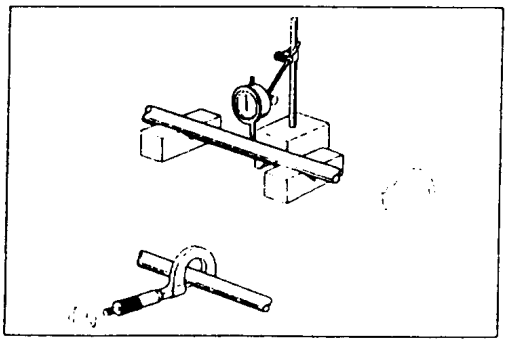
5 Remove the lift cylinder. **[Point 2]**

6 Remove the safety down valve.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
- **Do not reassemble dry parts, but apply hydraulic oil before reassembly.**
- **Apply sealant 08833-76002-71 (08833-00080) on the threaded portion of the rod guide.**
- **Rod guide tightening torque**
  T = 343.23~441.30 N•m (3500~4500 kgf-cm) [253.23~325.58 ft-lbf]



Point Operations

[Point 1]

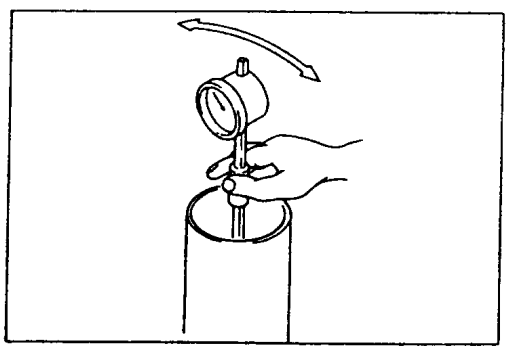
Inspection: Measure the piston rod outside diameter.

Unit: mm (in)

Model	Standard outside diameter	Limit outside diameter
FBMF16	70 (2.76)	69.91 (2.7524)
FBMF20·25	75 (2.95)	74.91 (2.9492)
FBMF30	85 (3.35)	84.90 (3.3425)

Inspection: Measure the piston rod bend.

Limit bend: 2.0 mm (0.079 in)



[Point 2]

Inspection: Measure the lift cylinder bore.

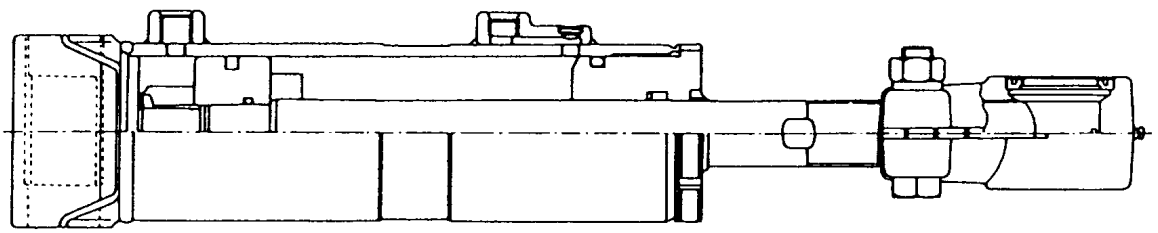
Unit: mm (in)

Model	Standard bore	Limit bore
FBMF16	85 (3.35)	85.40 (3.3622)
FBMF20·25	90 (3.54)	90.40 (3.5591)
FBMF30	105 (4.13)	105.40 (4.1496)

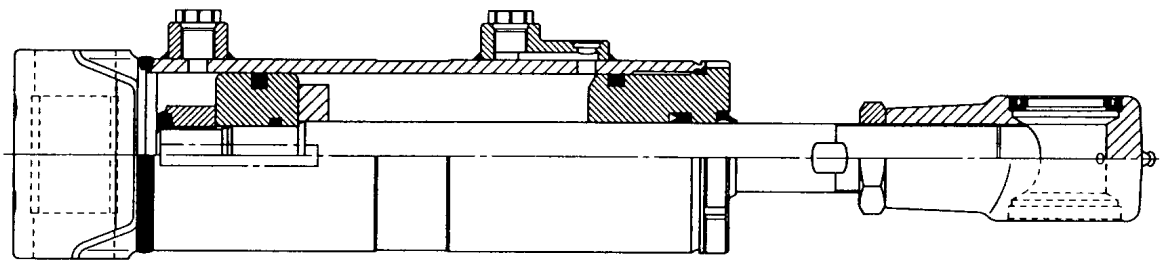
TILT CYLINDER (V·FV·FSV)

GENERAL

(1996.5 ~ 1997.4)



(1997.5 ~)

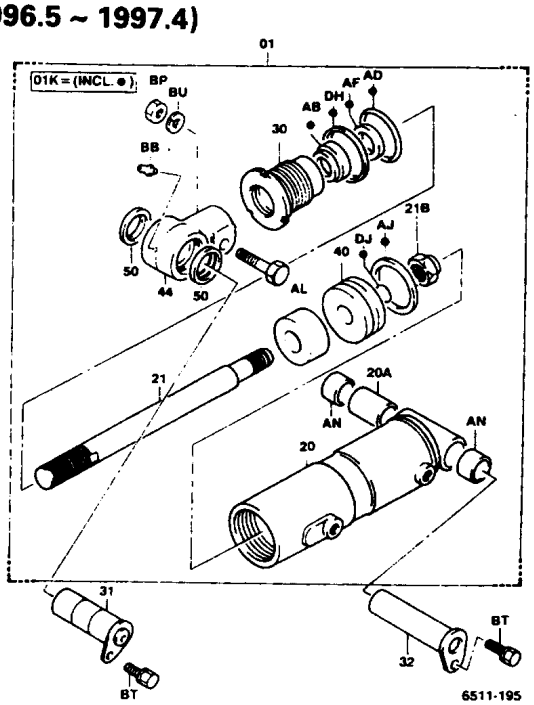


SPECIFICATIONS

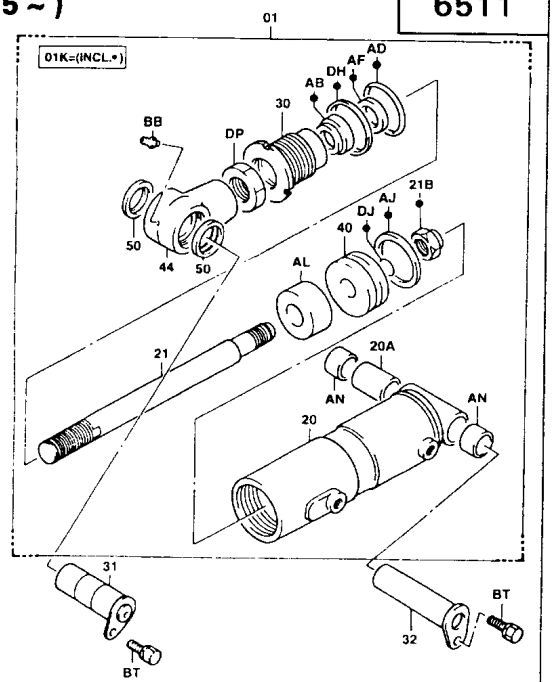
Cylinder type		Double acting
Cylinder bore	mm (in)	70 (2.76)
Piston rod outside diameter	mm (in)	30 (1.18)

COMPONENTS

(1996.5 ~ 1997.4)

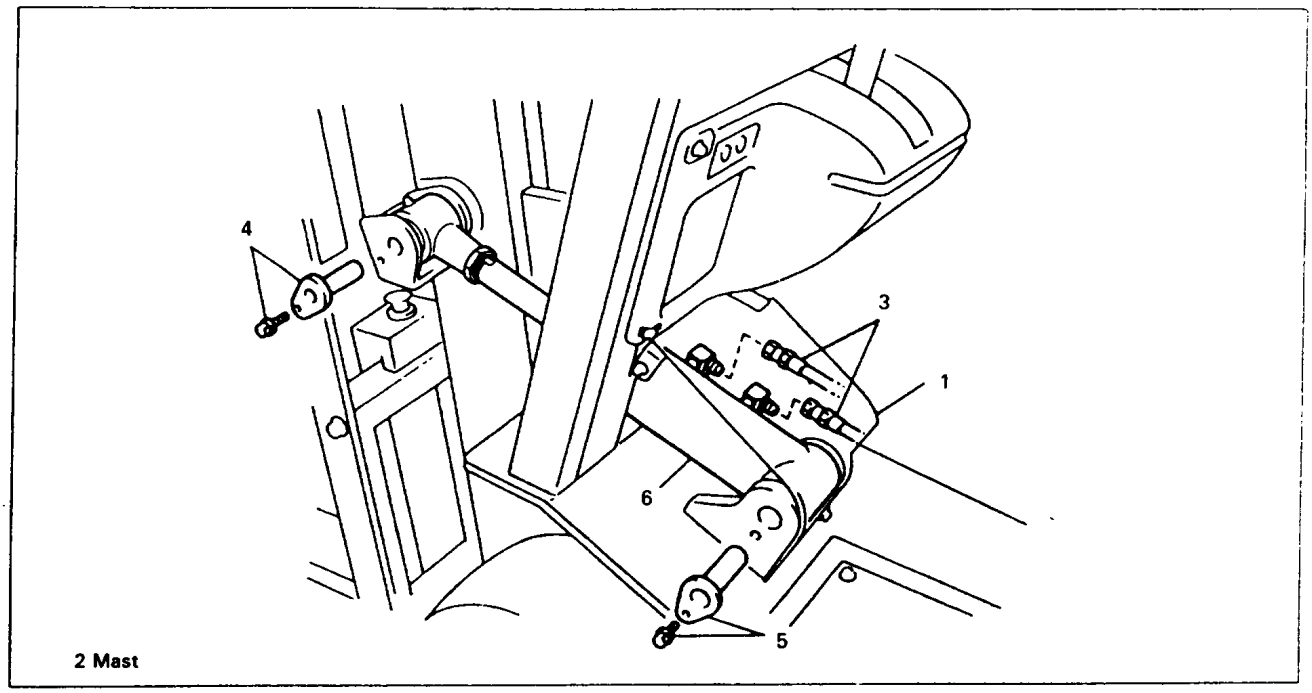


(1997.5 ~)



6511

REMOVAL·INSTALLATION



2 Mast

Removal Procedure

1 Remove the foot rest.

2 Hoist the mast.

3 Disconnect the hoses.

4 Remove the tilt cylinder front pin. **[Point 1]**

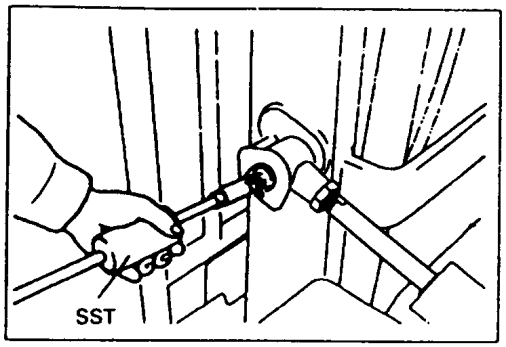
5 Remove the tilt cylinder rear pin.

6 Remove the tilt cylinder ASSY.

Installation Procedure

The installation procedure is the reverse of the removal procedure.

Note:
- **Apply MP grease on the tilt cylinder front pin and rear pin inserting portions.**
- **Tilt the mast slowly forward and backward a few times to confirm normal operation.**
- **Check the hydraulic oil level and add if insufficient.**
- **Tilt the mast fully forward and backward to check no uneven movements between the left and right sides. To adjust uneven movement, change the screw-in amount of the rod joint.**



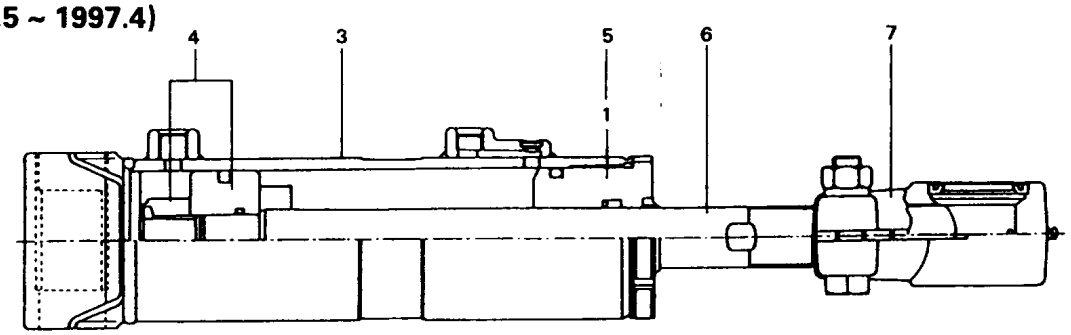
Point Operation

[Point 1]

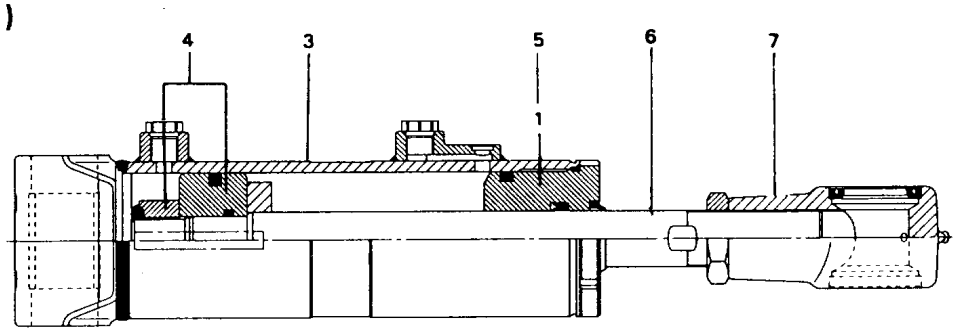
Removal: SST 09810-20172-71

DISASSEMBLY·INSPECTION·REASSEMBLY

(1996.5 ~ 1997.4)



(1997.5 ~)



2 Piston rod W/piston

Disassembly Procedure

1 Loosen the rod guide. [Point 1]

2 Extract the piston rod W/rod guide.

3 Remove the tilt cylinder. [Point 2]

4 Remove the piston.

5 Remove the rod guide.

6 Remove the piston rod. [Point 3]

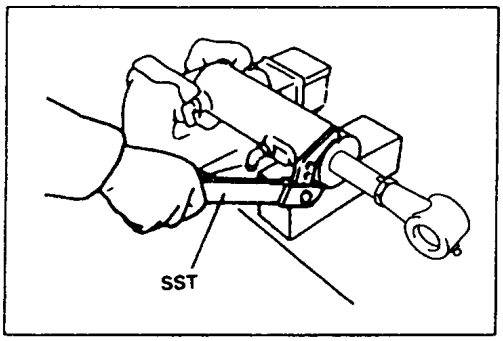
7 Remove the piston rod joint. [Point 4]

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

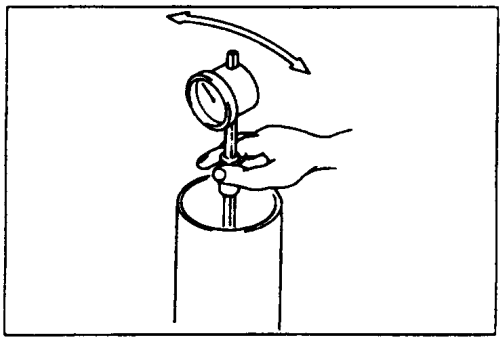
- **Do not disassemble dry parts but apply hydraulic oil before reassembly.**
- **Apply sealant 08833-76002-71 (08833-00080) on the threaded portion of the cylinder cover before tightening.**
- **Piston lock nut tightening torque**
  T = 260 ~ 350 N·m (2650 ~ 3570 kgf-cm) [191.72 ~ 258.29 ft-lbf]
- **Rod joint set bolt tightening torque (1996.6 ~ 1997.4)**
  T = 65 ~ 110 N·m (660 ~ 1120 kgf-cm) [47.75 ~ 81.03 ft-lbf]
- **Rod joint rock nut torque (1997.5 ~)**
  T = 360 N·m (3700 kgf-cm) [267 ft-lbf]
- **Rod guide tightening torque**
  T = 260 ~ 350 N·m (2650 ~ 3570 kgf-cm) [191.72 ~ 258.29 ft-lbf]



Point Operations

[Point 1]

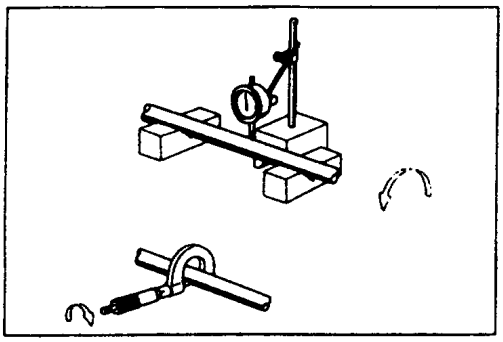
Disassembly·reassembly: SST 09620-10100-71



[Point 2]

Inspection: Measure the cylinder bore.

Standard bore: 70.0 mm (2.756 in)
Limit bore: 70.35 mm (2.7697 in)



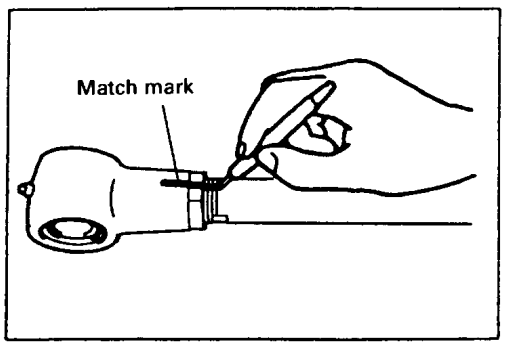
[Point 3]

Inspection: Measure the piston rod outside diameter.

Standard outside diameter:
30.0 mm (1.181 in)
Limit outside diameter:
29.92 mm (1.1780 in)

Inspection: Measure the piston rod bend.

Limit bend: 1.0 mm (0.039 in)

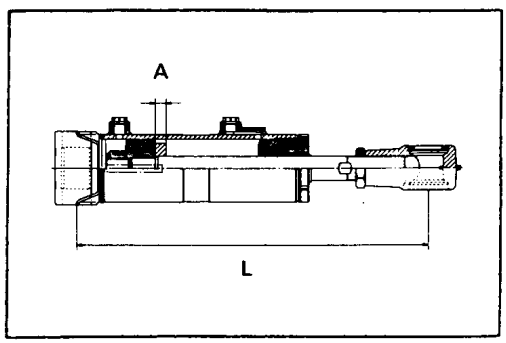


[Point 4]

Disassembly: Put match marks.

Reassembly: Align the match marks.

Reassembly: When the rod or rod joint is replaced, adjust the installed dimensions to be equal on the left and right sides.



FBMF16·20·25 Unit: mm (in)

Tilt value Forward/Backward	Dimension L (reference value)	Dimension A (spacer)
5°/9°	423 (16.65)	13 (0.51)
5°/6°	447 (17.60)	37 (1.46)

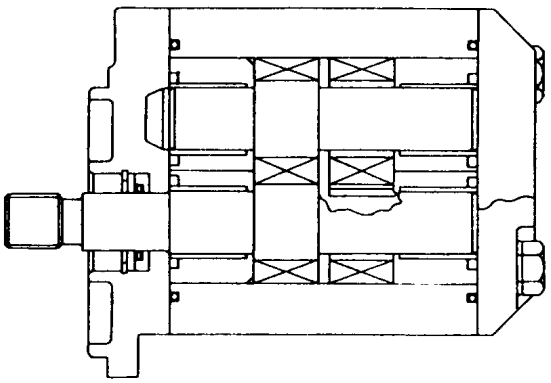
FBMF30 Unit: mm (in)

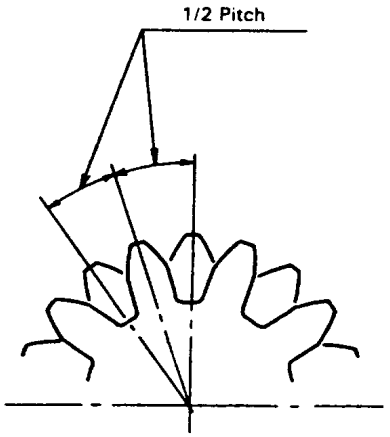
Tilt value Forward/Backward	Dimension L (reference value)	Dimension A (spacer)
5°/9°	425 (16.73)	0 (0)
5°/6°	452 (17.80)	27 (1.06)

OIL PUMP

GENERAL

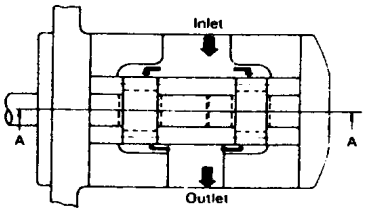
FBMF16

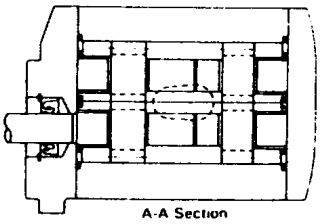




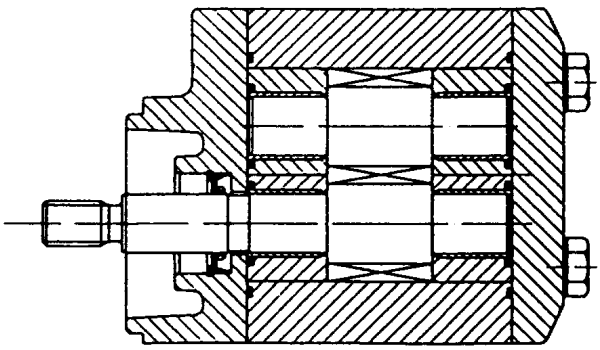
Displacement between front and rear gears

FBMF20·25





FBMF30

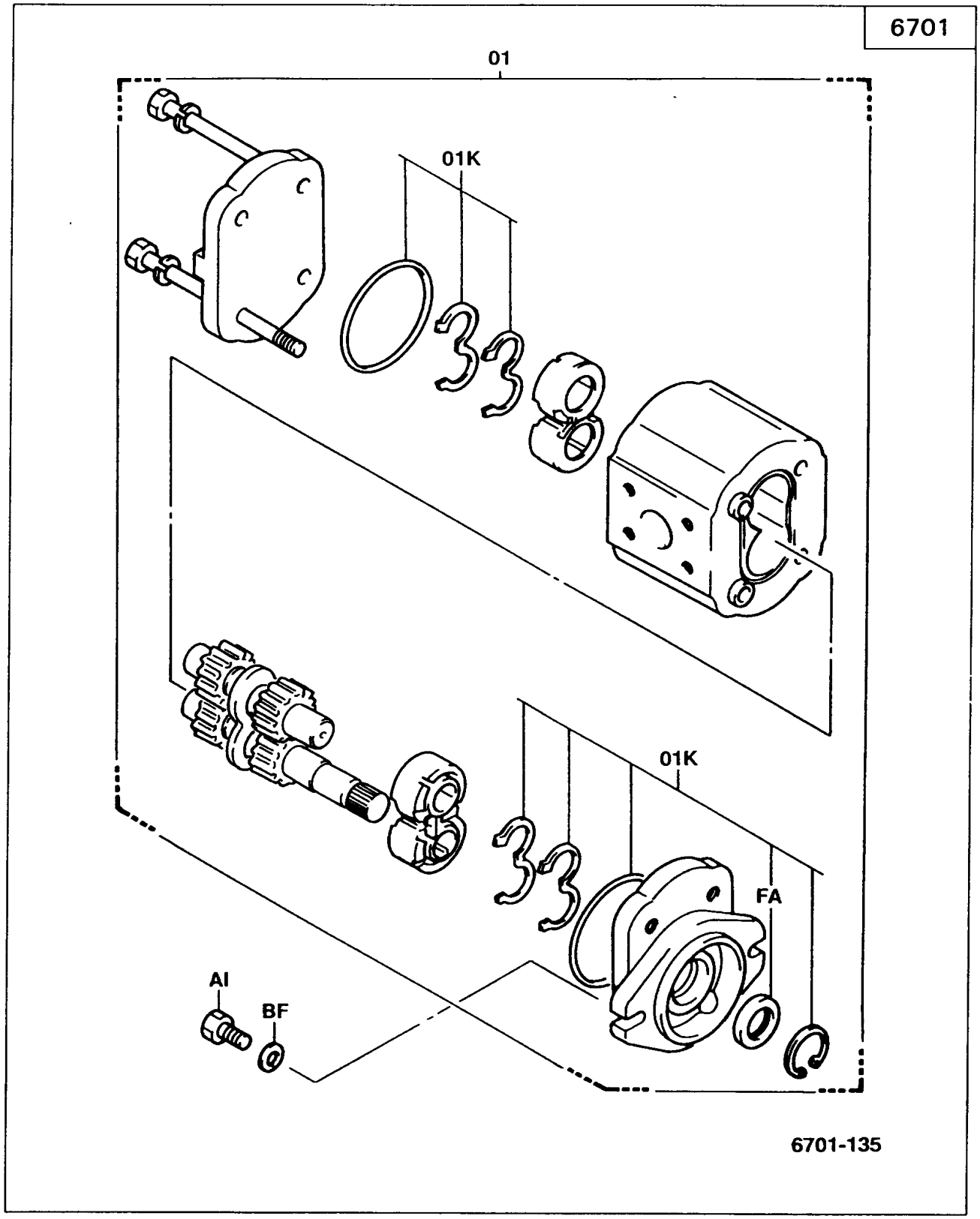


SPECIFICATIONS

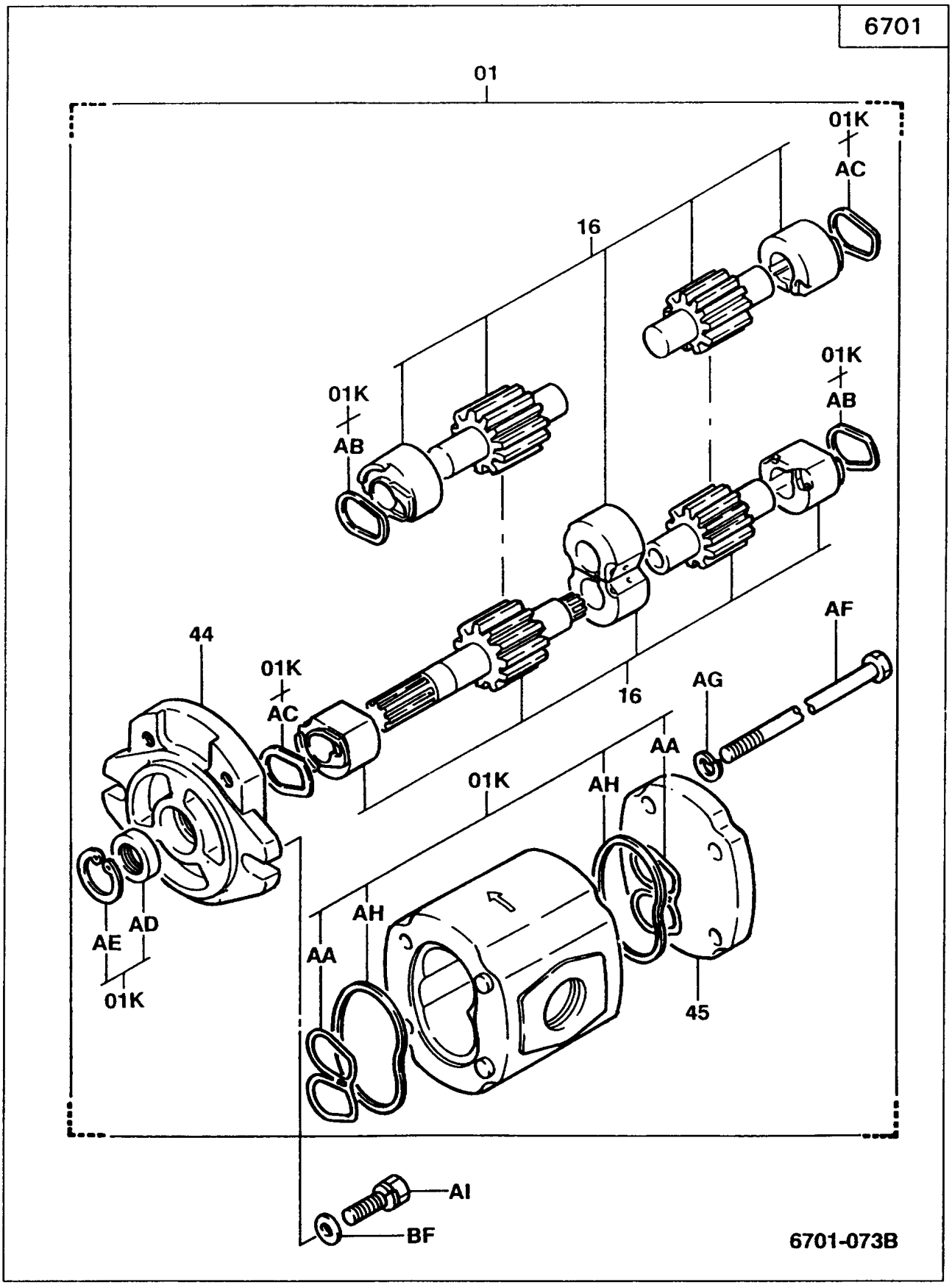
Vehicle type	FBMF16	FBMF20·25	FBMF30
Oil pump name	Double gear pump		Single gear pump
Oil pump type	1SX250	DGP4-27	2PX330
Drive method	Driving by direct coupling with the motor		
Theoretical discharge cc/rev (in³/rev)	25.0 (1.531)	26.5 (1.617)	33.0 (2.014)

COMPONENTS

FBMF16



FBMF20·25


6701
01
01K
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16
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44
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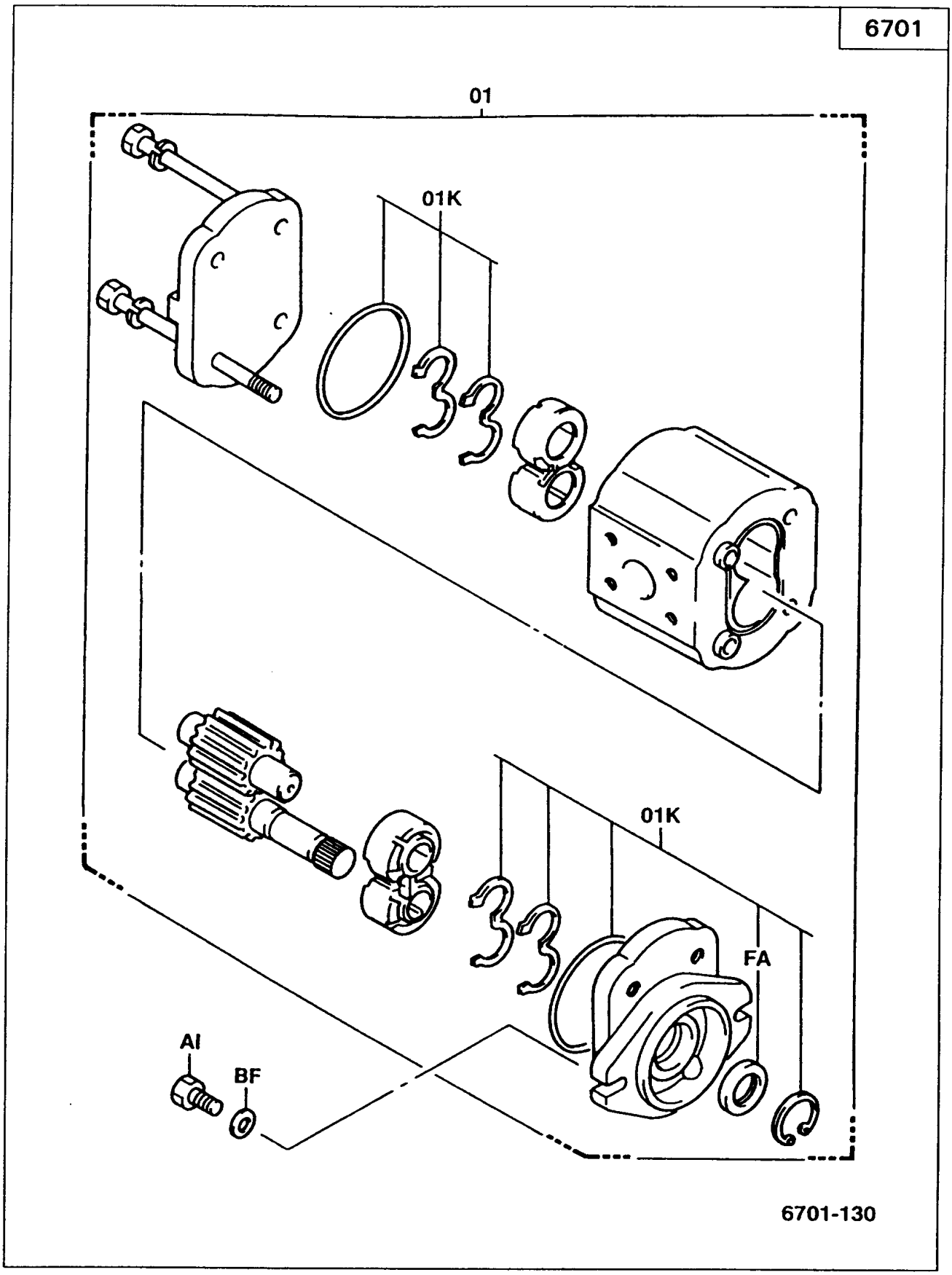
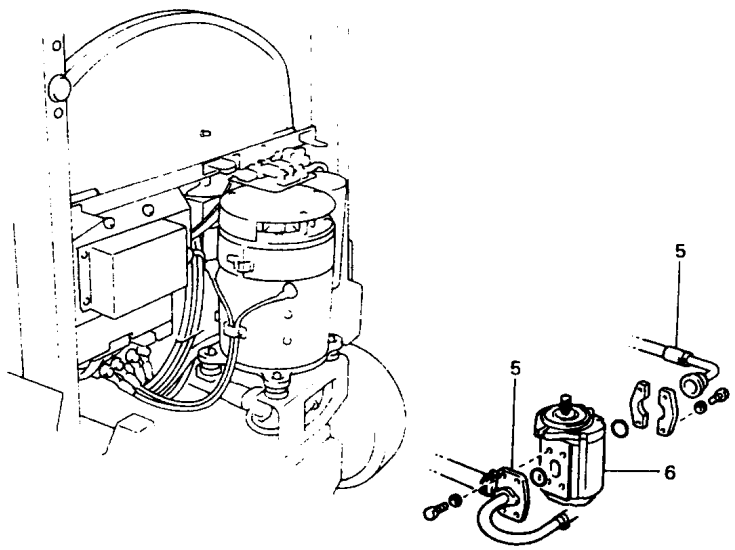
6701-073B

FBMF30



OIL PUMP ASSY

REMOVAL·INSTALLATION



1 Battery plug
2 Counter weight
3 Hydraulic oil
4 Under cover RH

Removal Procedure

1 Disconnect the battery plug.

2 Remove the counter weight. (See page on 13-6)

3 Drain hydraulic oil.

4 Remove the under cover RH.

5 Disconnect the oil pump piping.

6 Remove the oil pump.

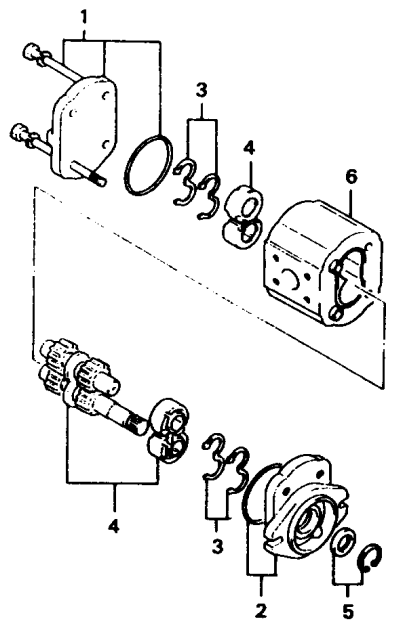
Installation Procedure

The installation procedure is the reverse of the removal procedure.

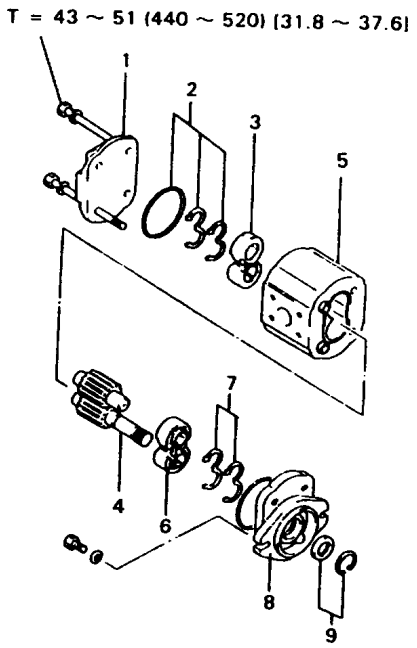
DISASSEMBLY·INSPECTION·REASSEMBLY (FBMF16, 30)

T=N·m (kgf-cm)[ft-lbf]

FBMF16



FBMF30



Disassembly Procedure

1 Remove the cover. **[Point 1]**

2 Remove the mounting flange. **[Point 1]**

3 Remove the backing ring, bushing seal and body seal.

4 Remove the gear and bushing set. **[Point 2]**

5 Remove the oil seal. **[Point 3]**

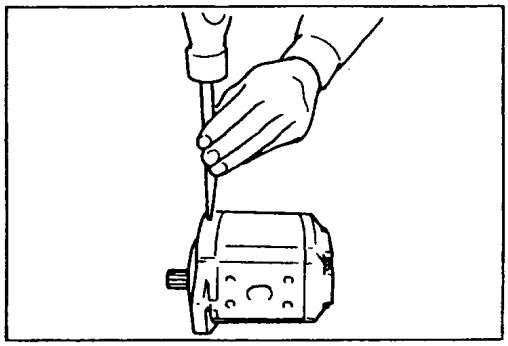
6 Remove the body. **[Point 4]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

- **Wash the parts, blow them with compressed air, and reassemble them after applying hydraulic oil.**
- **Always use new seals and backing ring when reassembling.**

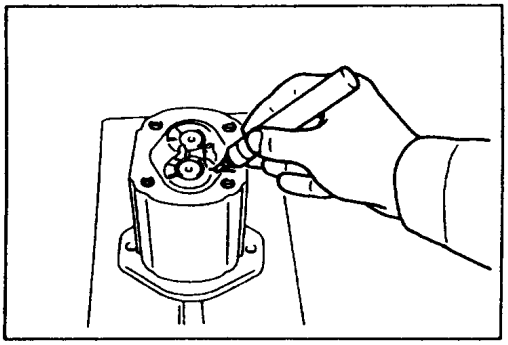


Point Operations

[Point 1]

Disassembly: Punch a match mark.

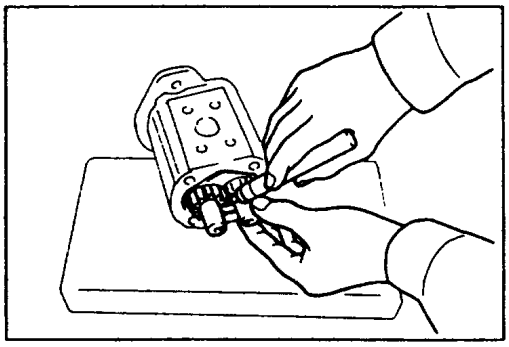
Reassembly: Align the match marks.



[Point 2]

Disassembly: Make a match mark. Do not damage the bushing.

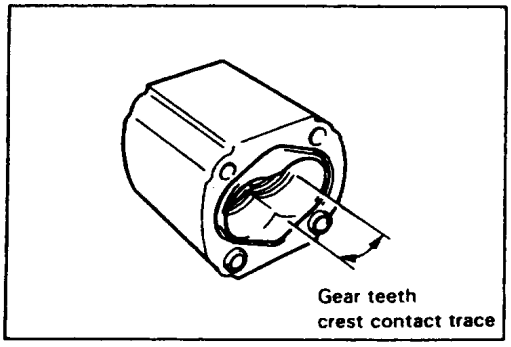
Reassembly: Align the match marks.



[Point 3]

Dosassembly: Make a match mark. Do not damage the gear.

Reassembly: Aligh the match marks.



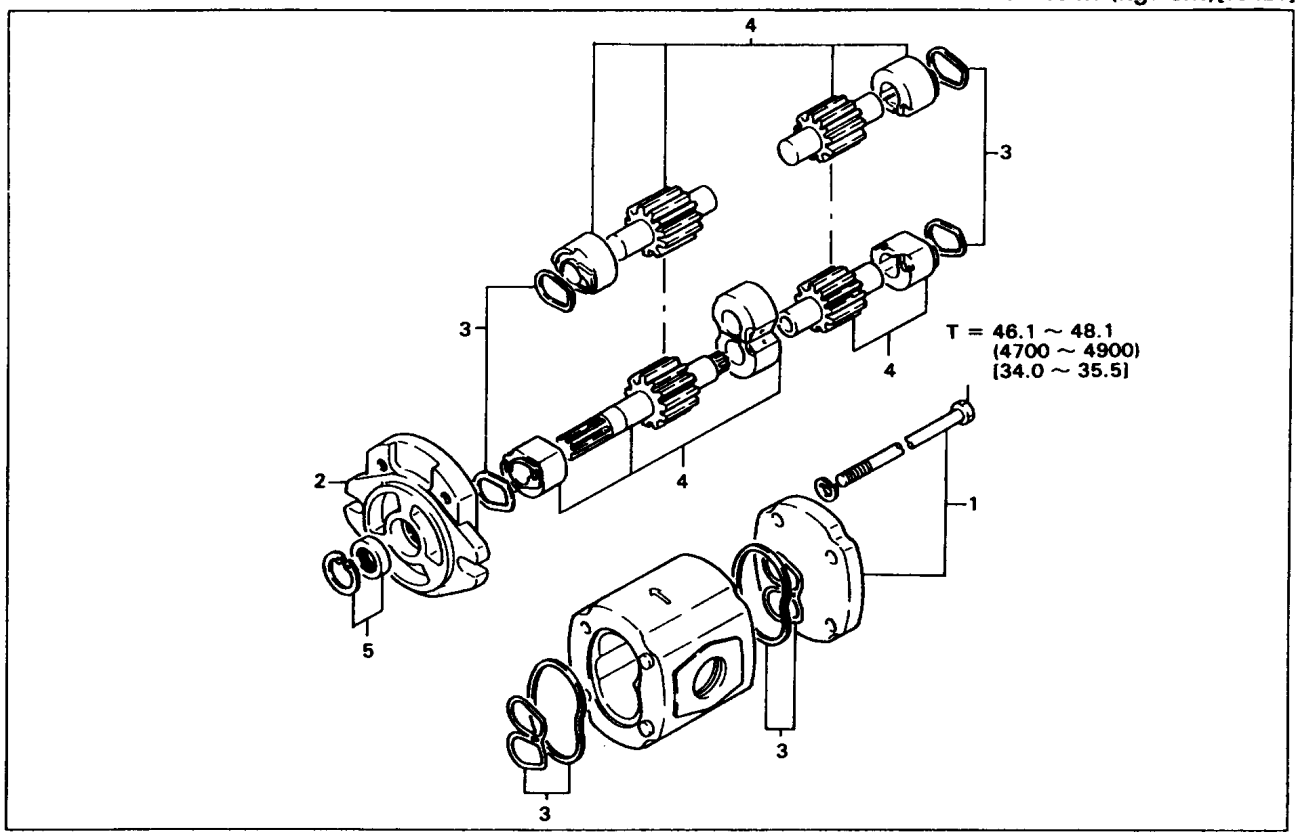
[Point 4]

Inspection: Inspect the depth of flaw on the inside surface of the body.

Limit flaw depth: 0.08 mm (0.003 in)

DISASSEMBLY·INSPECTION·REASSEMBLY (FBMF20, 25)

T=N·m (kgf-cm)[ft-lbf]



Disassembly Procedure

1 Remove the cover. **[Point 1]**

2 Remove the mounting flange. **[Point 2]**

3 Remove the backing ring, bush seal and body seal.

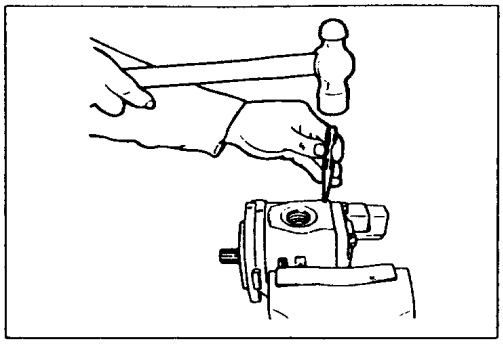
4 Remove the gear and bush set. **[Point 3]**

5 Remove the oil seal.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

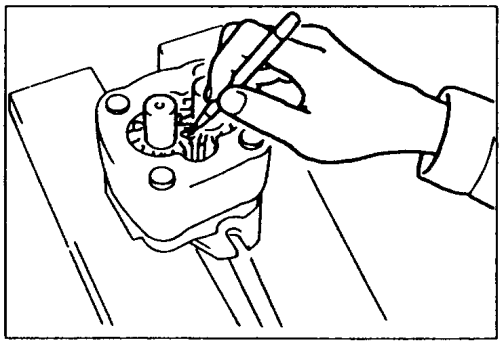
Note:
- **Wash each part, blow with compressed air, and coat hydraulic oil before reassembly.**
- **Always use new seals and backing ring for reassembly.**



Point Operations

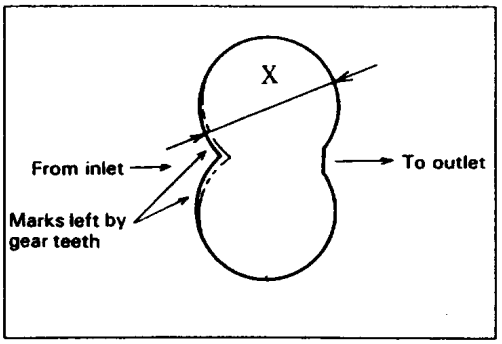
[Point 1]
Disassembly: Put a match mark.

Reassembly: Align the match marks.



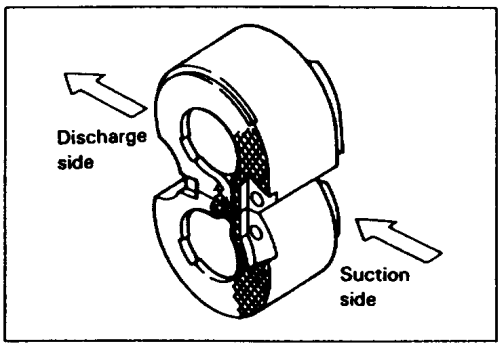
[Point 2]
Disassembly: Put a match mark on the teeth of the drive and driven gears.
Do not damage with a punch.

Reassembly: Align the match marks.



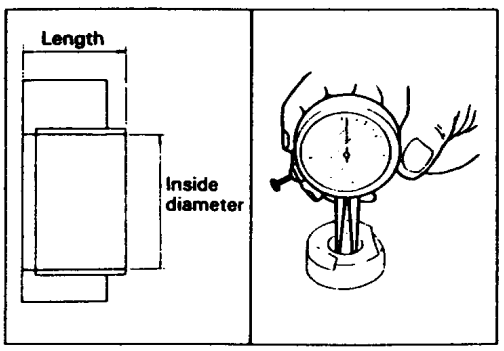
[Point 3]
Inspection: Measure the body inside diameter (X).
Limit: 39.180 mm (1.54252 in)

Inspection: Inspect the body for any interior surface flow.
Flow depth limit: 0.1 mm (0.004 in)



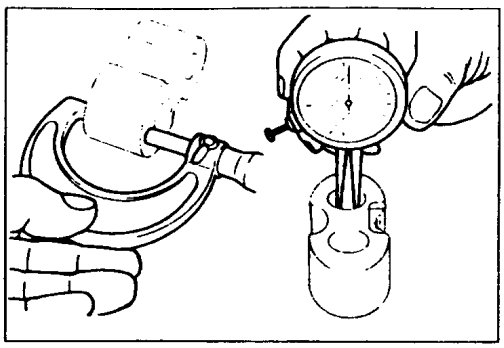
Inspection: Inspect the contact trace of the side busing.

Contact on bore sliding surface
Normal: Contact trace relatively stronger on the suction side and slight on the discharge side.



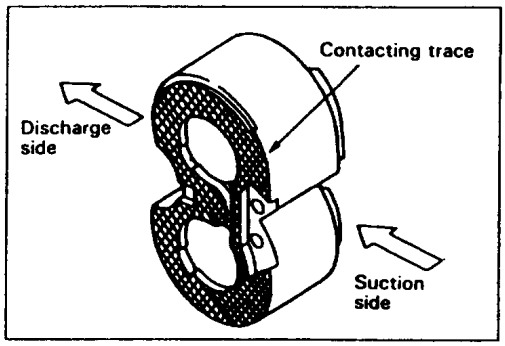
Inspection: Measure the side bush inside diameter.
Limit: 19.123 mm (0.75287 in)

Inspection: Measure the side bush length in axial direction.
Limit: 14.77 mm (0.58159 in)



Inspection: Inspect the center bush inside diameter.
Limit: 19.123 mm (0.75287 in)

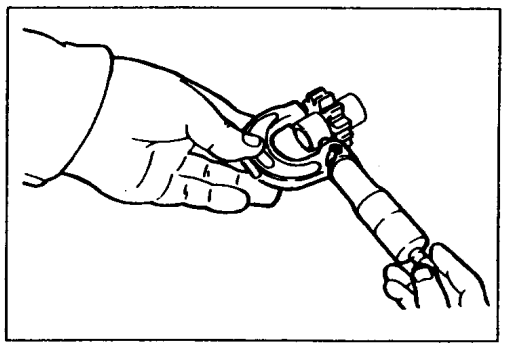
Inspection: Measure the center bush length in axial direction.
Limit: 29.68 mm (1.1685 in)



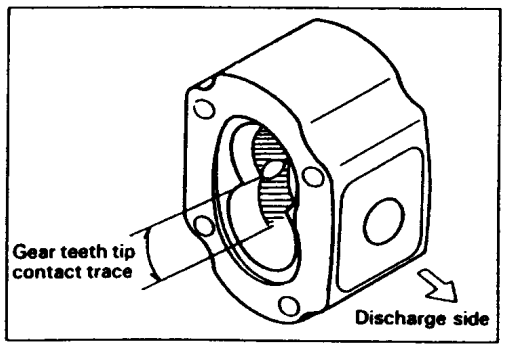
Inspection: Inspect the contact trace of the center busing.

Contact on bore sliding surface
Normal: Contact trace about 1/2 on the suction side.

Side contact
Normal: Overall contact trace.



Inspection: Measure the gear shaft outside diameter.
Limit: 18.935 mm (0.74547 in)



Inspection: Inspect the gear contact state on the body interior surface on the inlet side.
Limit: Contact trace at more than half of the body interior surface

TEST PROCEDURE

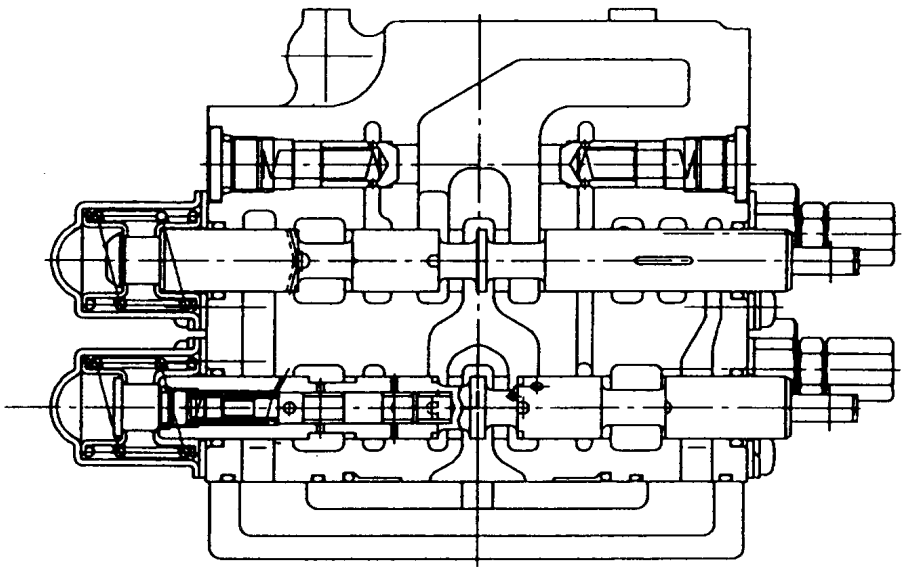
Note:
A bench test is required for strict inspection, but it is impossible in actual service. Install the oil pump on the actual vehicle and judge the properness of the oil pump state by checking the cylinder operation.
Check on the battery indicator if the battery charge is sufficient.
Check if the oil control valve relief set pressure is as specified.
For further details, see "OIL CONTROL VALVE ADJUSTMENT".
Raise the hydraulic oil temperature to 50 to 55°C (122 to 131°F), and measure the lift cylinder full stroke operation time to calculate the lifting speed.
However, soft start supported by the material chopper circuit makes lifting speeds 10 to 20 mm/sec (2.0 to 3.9 fpm) lower than the values listed in the table below. To measure lifting speeds more accurately, measure them except during the soft start.
If any fault is found, disassemble and inspect the oil pump again.

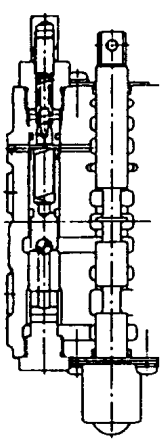
Lifting Speed Table

Model	Specification	Mast type	Lifting speed mm/s (fpm)	
			No loaded	Loaded
FBMF16	80V	V	750 (147)	470 (93)
		FV·FSV	640 (126)	430 (85)
	72V	V	600 (118)	420 (83)
		FV·FSV	560 (110)	390 (77)
FBMF20	80V	V	600 (118)	440 (87)
		FV·FSV	540 (106)	410 (81)
	72V	V	550 (108)	400 (79)
		FV·FSV	510 (100)	380 (75)
FBMF25	80V	V	600 (118)	420 (83)
		FV·FSV	540 (106)	390 (77)
	72V	V	550 (108)	380 (75)
		FV·FSV	510 (100)	360 (71)
FBMF30	80V	V	520 (102)	400 (79)
		FV·FSV	440 (87)	290 (57)
	72V	V	470 (93)	360 (71)
		FV·FSV	400 (79)	250 (49)

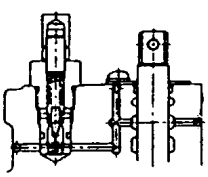
OIL CONTROL VALVE

GENERAL

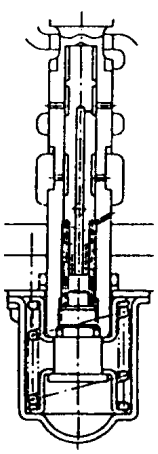




Lift releif valve



Tilt relief valve



Tilt lock valve

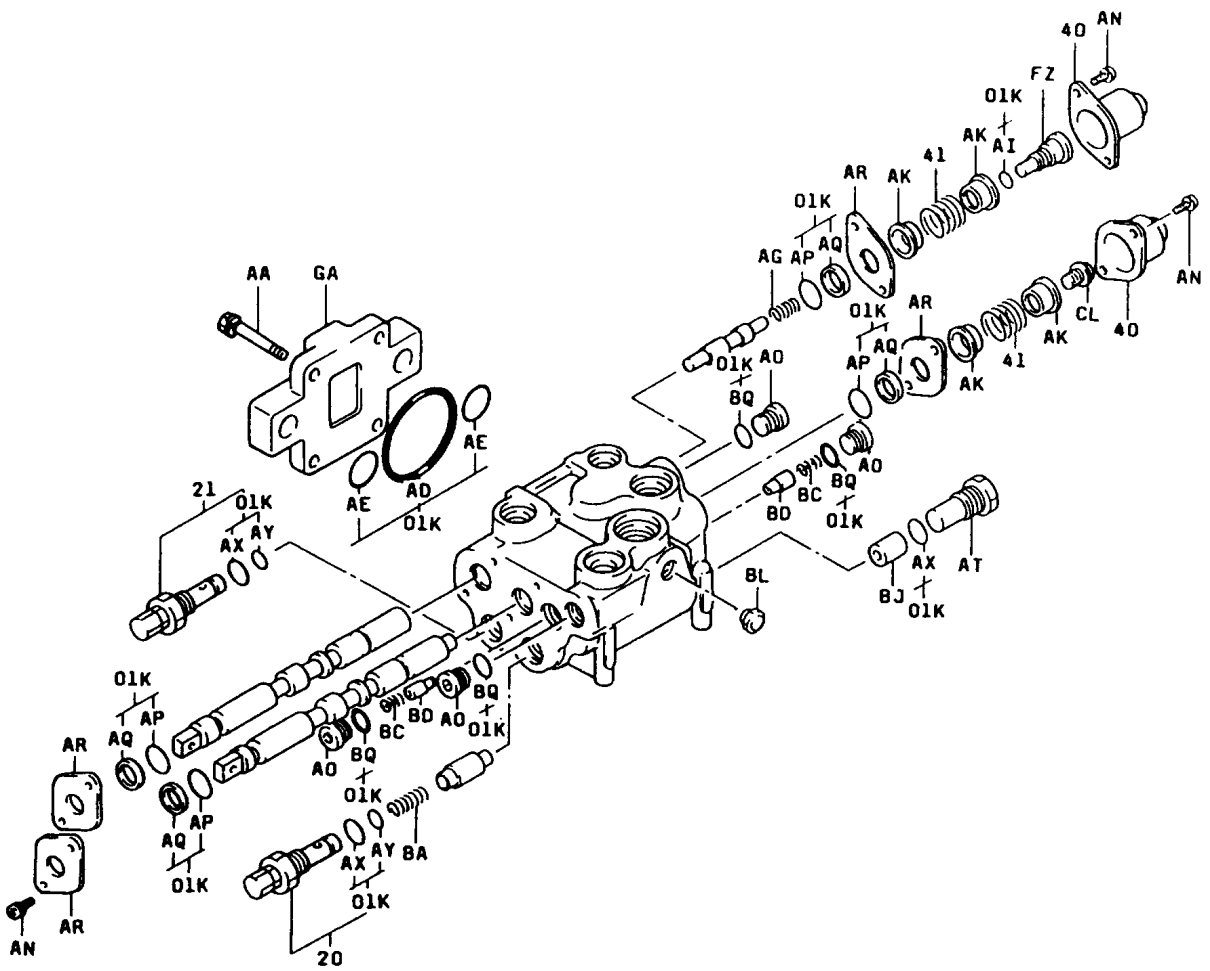
SPECIFICATIONS

Oil Control Valve

Item \ Models		FBMF16	FBMF20·25	FBMF30
Oil control valve type		Add-on	←	←
Relief pressure kPa (kgf/cm²)[psi]	Lift	15200 (155)[2200]	17160 (175)[2490]	18140 (185)[2630]
	Tilt	11770 (120)[1710]	14710 (150)[2130]	←
Spool outside diameter	mm (in)	16.0 (0.630)	←	←
Stroke	mm (in)	7.0 (0.276)	←	←
Others		Built-in tilt lock valve	←	←

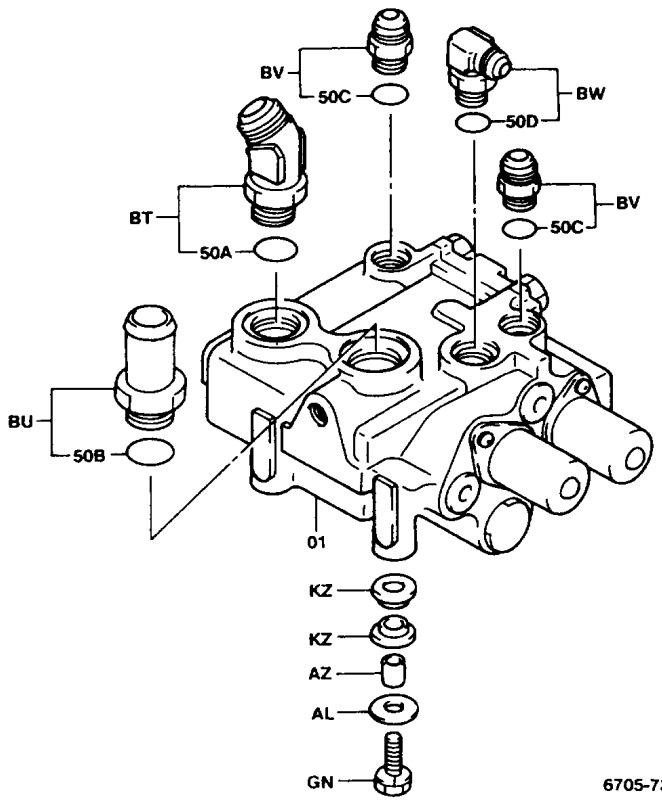
COMPONENTS

6705

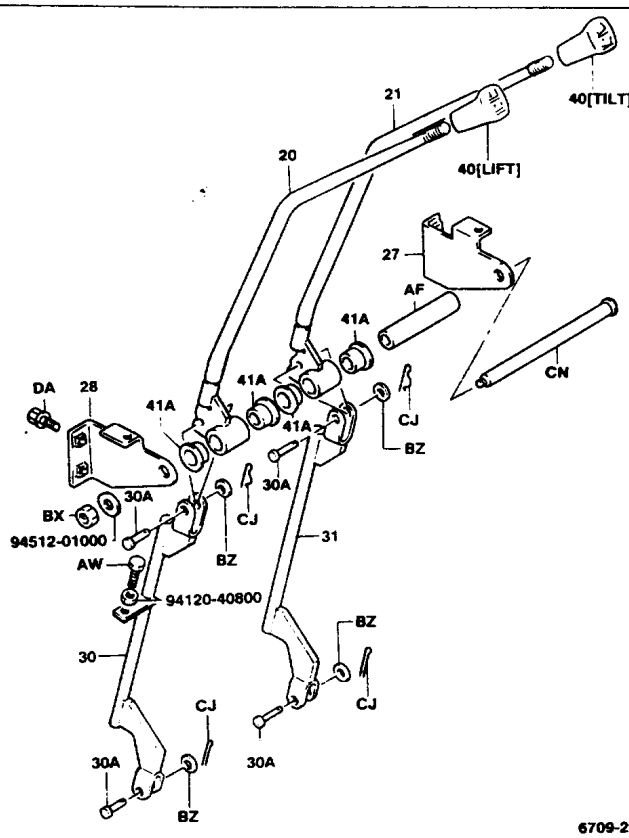


6705-590

6705


BV
50C
BW
50D
BT
50A
BV
50C
BU
50B
01
KZ
KZ
AZ
AL
GN
6705-731

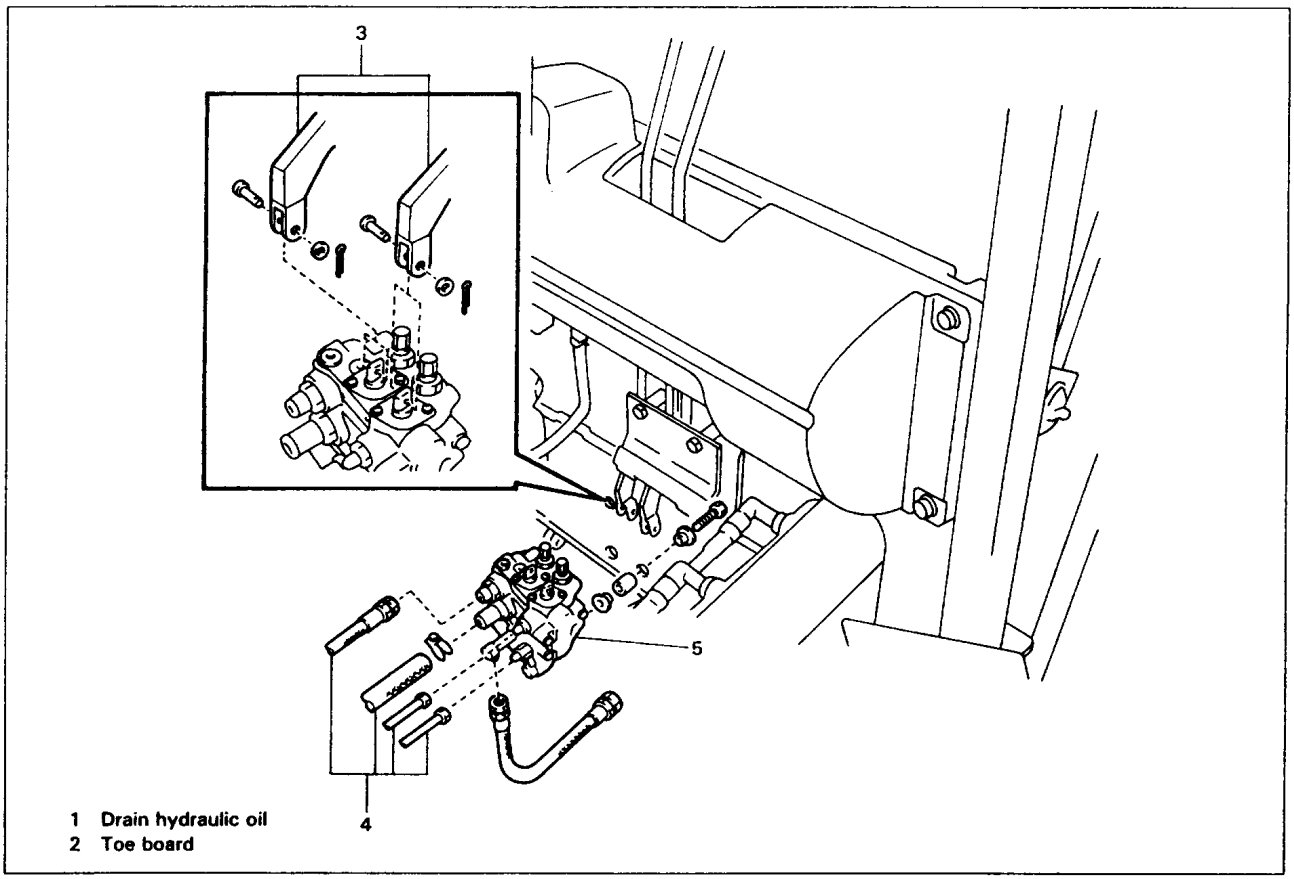
6709


40[TILT]
21
40[LIFT]
20
27
AF
41A
CN
DA
28
41A
41A
41A
CJ
BZ
30A
30A
BX
CJ
94512-01000
BZ
31
AW
94120-40800
BZ
30
CJ
CJ
30A
30A
BZ
6709-291

OIL CONTROL VALVE ASSY

REMOVAL·INSTALLATION

Note:
Before starting removal operation, operate the control valve lever. Set the mast in vertical position and lower the fork fully to eliminate the remaining pressure in the material handling system piping.



Removal Procedure

1 Drain hydraulic oil from the oil tank.

2 Remove the toe board.

3 Disconnect the control valve levers.

4 Disconnect the piping.

5 Remove the oil control valve.

Installation Procedure

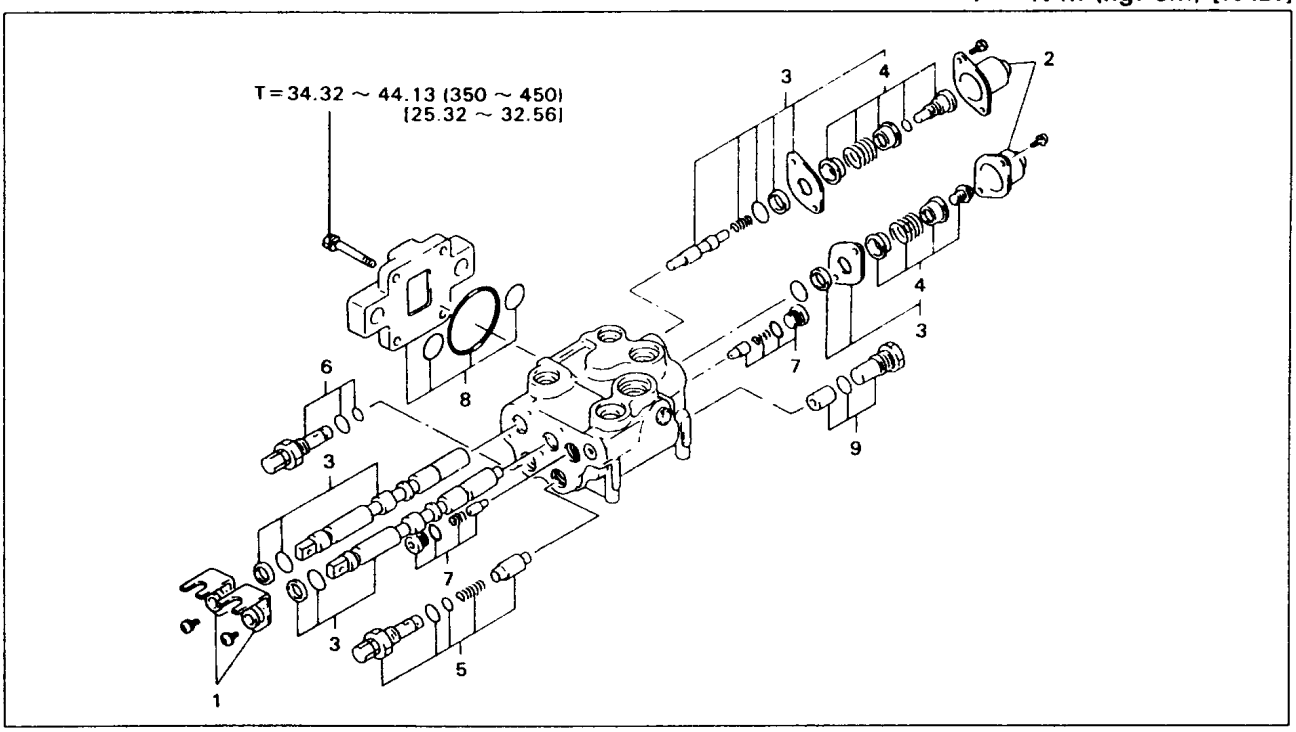
The installation procedure is the reverse of the removal procedure.

Note:
- **After installing the oil control valve, adjust the limit switch and lift potentiometer (according to the procedure on page 4-33).**
- **Coat grease on the oil control valve lever link parts.**
- **Inspect the hydraulic oil level and add if insufficient.**

DISASSEMBLY·INSPECTION·REASSEMBLY

Note:
Select a clean place for disassembly operation.
As parts are finished with high precision, carefully handle them to prevent damaging.

T = N·m (kgf-cm) [ft-lbf]



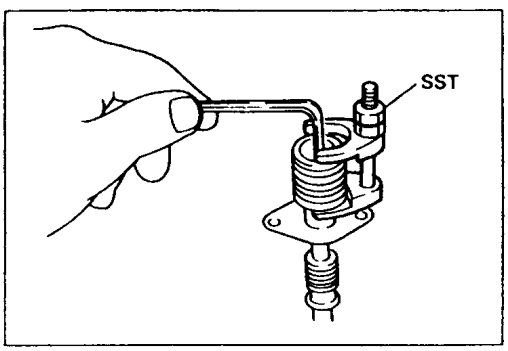
Disassembly Procedure

1 Remove the seal holder.
2 Remove the spring cover.
3 Remove the lift and tilt spools.
4 Disassemble the lift and tilt spools.
[Point 1]
5 Remove the lift relief valve.
6 Remove the tilt relief valve.
7 Remove the check plunger.
8 Remove the outlet housing.
9 Remove the valve seat.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
- **Wash the parts thoroughly, blow them with compressed air, and assemble them after coating hydraulic oil.**
- **Fully loosen the relief valve adjusting screw.**



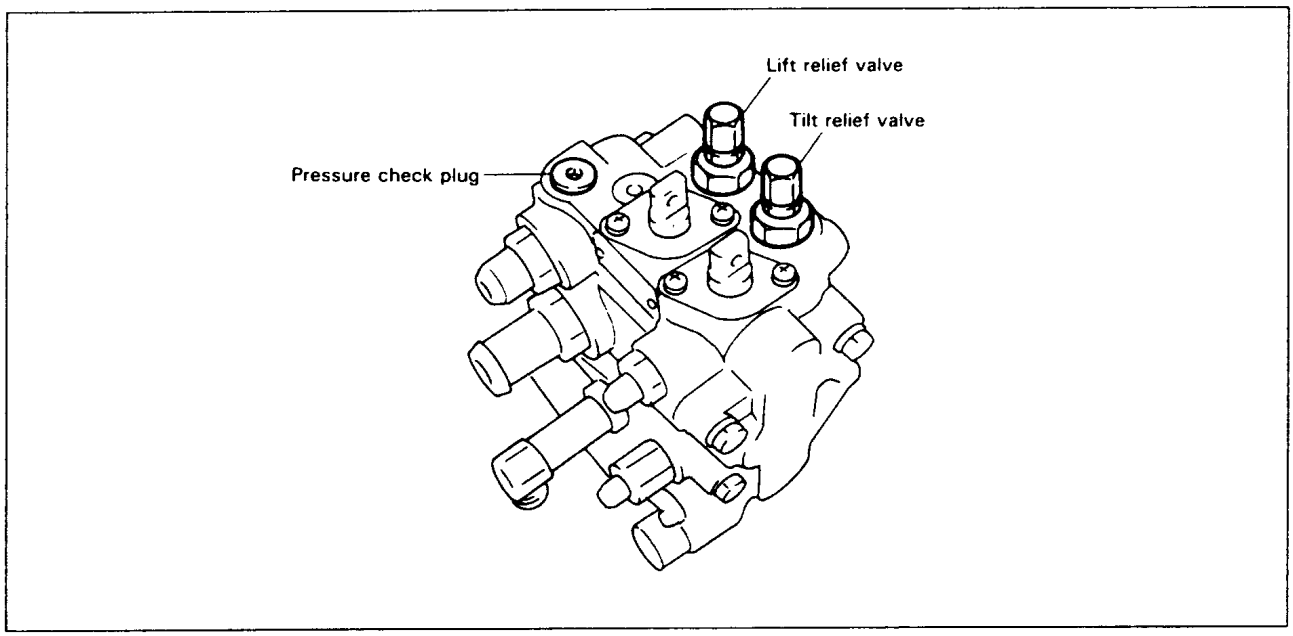
Point Operation

[Point 1]
Disassembly·reassembly: SST 09610-10160-71

ADJUSTMENT

Relief Pressure Adjustment

Note:
- **Make adjustment always according to the following procedure. Random adjustment may generate a high pressure to damage the oil pump and other hydraulic equipment.**
- **No adjustment is required when the relief valve is not assembled or is replaced with a new part.**



1 Remove the pressure check plug, and install an oil pressure gage.

Oil pressure gage: Pressure resistance at 19610 kPa (200 kgf/cm²) [2840 psi] or more

2 Loosen the lock nut, and loosen the adjusting screw to a degree not coming off from the body.

3 Adjust the lift relief valve oil pressure.
(1) Turn the key switch to ON.
(2) Set the lift lever slowly to the lift position, and tighten the adjusting screw gradually before the fork starts to rise.
(3) Lift the fork fully to the maximum height, and read the oil pressure at the position. Tighten the adjusting screw so that the pressure at the time becomes normal.
(4) Tighten the lock nut and check the oil pressure again.

4 Adjust the tilt relief valve oil pressure.
(1) Follow the same procedure as that for lifting.
(2) Tilt the mast fully backward when measuring the oil pressure.

Relief Pressure Table

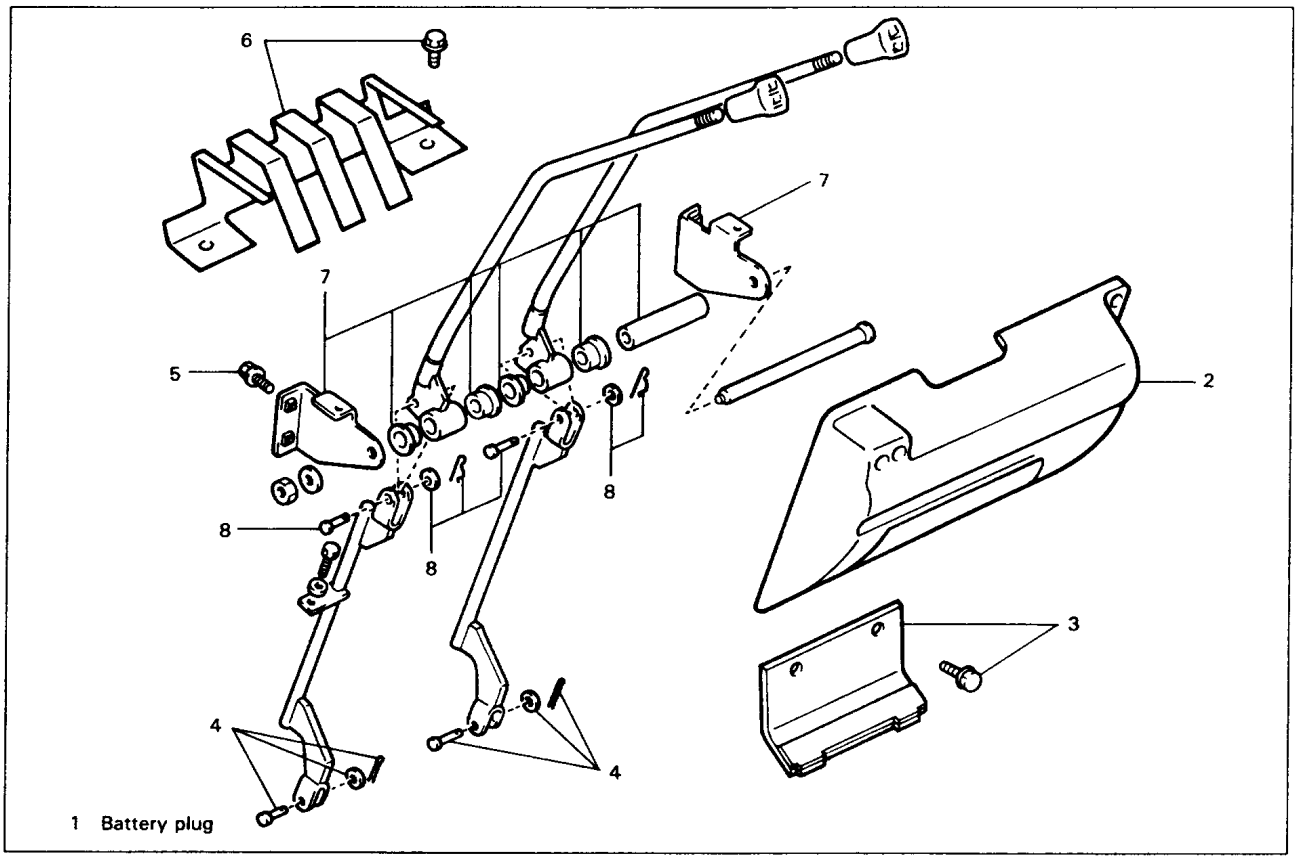
Unit: kPa (kgf/cm²)[psi]

	FBMF16	FBMF20·25	FBMF30
Lift relief pressure	15200 (155)[2000]	17160 (175) [2490]	18140 (185)[2630]
Tilt relief pressure	11700 (120)[1710]	14710 (150)[2130]	←

5 Remove the oil pressure gage, and install the check valve.

CONTROL VALVE LEVER ASSY

REMOVAL·INSTALLATION

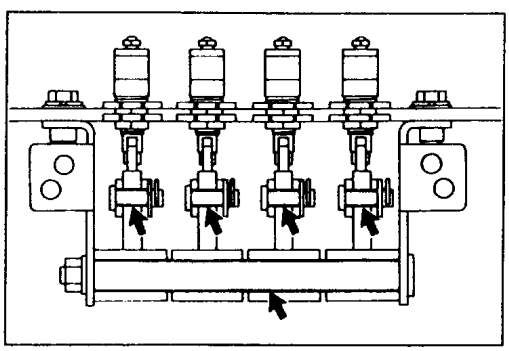


Removal Procedure

1 Disconnect the battery plug.
2 Remove the instrument panel RH.
3 Remove the plate.
4 Disconnect the control valve lever from control valve. **[Point 1]**
5 Remove the control valve lever ASSY.
6 Remove the lever guide.
7 Remove the valve lever bracket.
8 Disassemble the control valve lever. **[Point 2]**

Installation Procedure

The installation procedure is the reverse of the removal procedure.



Point Operation

[Point 1]

Installation: Coat grease on the pin and bolt surface.

APPENDIX

LIST OF SPECIFICATIONS

1	Manufacturer					TOYOTA		TOYOTA
2	Model					**FBMF16**		**FBMF20**
3	Load Capacity				kg	1600		2000
4	Load Center				mm	500		500
5	Power Type					Battery		Battery
6	Operator Position					Rider Seated		Rider Seated
7	Tire Type			Front/Rear		Pneumatic-Shaped Cushion		Pneumatic-Shaped Cushion
8	Wheels (x = driven)			Front/Rear		2x/2		2x/2
9	Maximum Fork Height (MFH)				mm	3300		3300
10	Free Lift				mm	145		125
13	Fork Size			T x W x L	mm	40x80x800		40x100x1100
14	Tilt Range			FWD/BWD	deg	5/9		5/9
15	Length to Fork Face				mm	2070		2225
16	Overall Width				mm	1115 [1075]		1180
17	Mast Lowered Height				mm	2120 [2145]		2140
18	Mast Extended Height				mm	4520		4520
19	Overhead Guard Height				mm	2160 [2185]		2180
21	Turning Radius (Outside)				mm	1800		1960
22	Load Distance (Centerline of front axle to front face of forks)				mm	405		420
23	Basic Right Angle Stacking Aisle Width (Add load length and clearance)				mm	2200		2370
24	Speeds	Travel Max. (FWD/RVS)		Full Load	km/h	13/13	14/14	14/14 15/15
				No Load	km/h	15/15	16/16	16/16 17/17
25		Lifting		Full Load	mm/sec	420	470	400 440
				No Load	mm/sec	600	680	550 600
26		Lowering		Full Load	mm/sec	500		500
				No Load	mm/sec	550		500
27	Drawbar Pull *	Full Load/ No Load		3-Minute Ratings	kg	810/750	830/770	1100/1060 950/920
				5-Minute Ratings	kg	710/660	720/670	890/860 790/760
				60-Minute Ratings	kg	260/250	260/250	340/340 320/320
29	Gradeability *	Full Load/ No Load		3-Minute Ratings	% (tanθ)	16/22	16/22	18/26 15/23
				5-Minute Ratings	% (tanθ)	14/19	14/19	14/21 13/19
				30-Minute Ratings	% (tanθ)	6/9	7/9	7/10 6/9
32	Total Weight	Without Battery			kg	2220		2490
33	Weight Distribution (With STD Battery)	Full Load		Front	kg	4490		5390
				Rear	kg	570		660
34		No Load		Front	kg	1820		2165
				Rear	kg	1640		1885
35	Tires	Number		Front/Rear		2/2		2/2
36		Size		Front		21x8-9 [6.50-10]		23x9-10
37				Rear		5.00-8		18x7-8
38	Wheelbase				mm	1360		1505
39	Tread			Front	mm	920 [890]		955
				Rear	mm	890		935
40	Underclearance	Min. with Load			mm	90		110
41		Center of Wheelbase			mm	110 [125]		130
42	Brake	Service (Foot)				Hydraulic		Hydraulic
43		Parking				Hand		Hand
45	Battery	Voltage/Capacity (5-hour rating)	STD		V/AH	72/360	80/360	72/480 80/480
			High		V/AH	72/450	80/450	72/600 80/600
46		Minimum Weight			kg	1240		1560
47	Electric Motors	Drive			KW	7.6	8.6	9.7 10.6
48		Load Handling			KW	11.5	13	14.8 17
		Power Steering			KW	1		1
54	Control Type	Drive				Transistor chopper		Transistor chopper
		Load Handling				Transistor chopper		Transistor chopper
		Power Steering				Transistor chopper		Transistor chopper
57	Operating Pressure	For Attachments			kg/cm^2	120		150

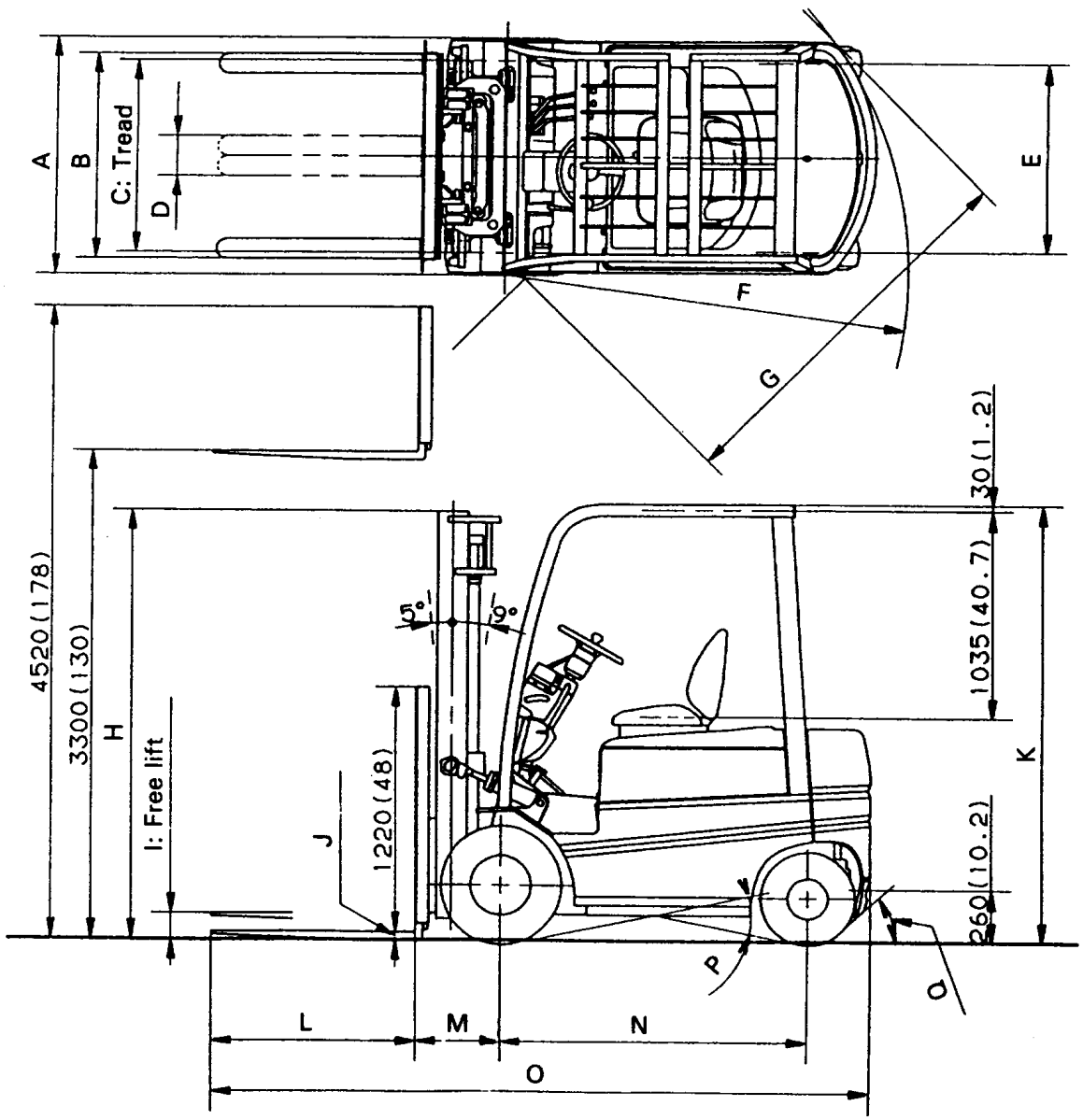
NOTE: * Computed values.
[ ] with optional tire size; 6.50-10-12PR.
The battery case forms an integral part of the truck body so that the indicated "Total Weight" of these models includes the weight of the battery case.

1	Manufacturer				TOYOTA		TOYOTA	
2	Model				FBMF25		FBMF30	
3	Load Capacity			kg	2500		3000	
4	Load Center			mm	500		500	
5	Power Type				Battery		Battery	
6	Operator Position				Rider Seated		Rider Seated	
7	Tire Type	Front/Rear			Pneumatic-Shaped Cushion		Pneumatic-Shaped Cushion	
8	Wheels (x = driven)	Front/Rear			2x/2		2x/2	
9	Maximum Fork Height (MFH)			mm	3300		3300	
10	Free Lift			mm	130		135	
13	Fork Size	T x W x L		mm	40x100x1100		45x100x1100	
14	Tilt Range	FWD/BWD		deg	5/9		5/9	
15	Length to Fork Face			mm	2255		2480	
16	Overall Width			mm	1180		1240	
17	Mast Lowered Height			mm	2140		2165	
18	Mast Extended Height			mm	4520		4520	
19	Overhead Guard Height			mm	2180		2275	
21	Turning Radius (Outside)			mm	1980		2130	
22	Load Distance (Centerline of front axle to front face of forks)			mm	420		485	
23	Basic Right Angle Stacking Aisle Width (Add load length and clearance)			mm	2400		2615	
24	Speeds	Travel Max. (FWD/RVS)	Full Load	km/h	13/13	14/14	12/12	13/13
			No Load	km/h	15/15	16/16	14/14	15/15
25		Lifting	Full Load	mm/sec	380	420	360	400
			No Load	mm/sec	550	600	470	520
26		Lowering	Full Load	mm/sec	500		500	
			No Load	mm/sec	500		500	
27	Drawbar Pull *	Full Load/ No Load	3-Minute Ratings	kg	1090/1050	950/910	1190/1160	1030/1010
			5-Minute Ratings	kg	890/850	780/760	960/940	850/830
			60-Minute Ratings	kg	330/340	310/310	350/360	320/340
29	Gradeability *	Full Load/ No Load	3-Minute Ratings	% (tanθ)	15/24	13/20	14/22	12/19
			5-Minute Ratings	% (tanθ)	12/19	11/17	11/17	10/15
			30-Minute Ratings	% (tanθ)	5/9	5/8	5/8	4/7
32	Total Weight	Without Battery		kg	2830		3365	
33	Weight Distribution (With STD Battery)	Full Load	Front	kg	6160		7360	
			Rear	kg	730		895	
34		No Load	Front	kg	2130		2570	
			Rear	kg	2260		2685	
35	Tires	Number	Front/Rear		2/2		2/2	
36		Size	Front		23x9-10		28X9-15	
37			Rear		18x7-8		18x7-8	
38	Wheelbase			mm	1505		1650	
39	Tread		Front	mm	955		1010	
			Rear	mm	935		935	
40	Underclearance	Min. with Load		mm	110		120	
41		Center of Wheelbase		mm	130		225	
42	Brake	Service (Foot)			Hydraulic		Hydraulic	
43		Parking			Hand		Hand	
45	Battery	Voltage/Capacity (5-hour rating)	STD	V/AH	72/480	80/480	72/600	80/600
			High	V/AH	72/600	80/600	72/750	80/750
46		Minimum Weight		kg	1560		1865	
47	Electric Motors	Drive		KW	9.7	10.6	9.7	10.6
48		Load Handling		KW	14.8	17	16.5	18.5
		Power Steering		KW	1		1	
54	Control Type	Drive			Transistor chopper		Transistor chopper	
		Load Handling			Transistor chopper		Transistor chopper	
		Power Steering			Transistor chopper		Transistor chopper	
57	Operating Pressure	For Attachments		kg/cm²	150		150	

NOTE: * Computed values.
[ ] with optional tire size; 6.50-10-12PR.
The battery case forms an integral part of the truck body so that the indicated "Total Weight" of these models includes the weight of the battery case.

DIMENSIONAL DRAWINGS

VEHICLE DIMENSIONAL DRAWINGS



Unit: mm (in)

Unit: mm (in)

	FBMF 16	FBMF 20	FBMF 25	FBMF 30
A	1115 (43.9)	1180 (46.5)	←	1240 (48.8)
B	920 (36.2)	1020 (40.2)	←	1070 (42.1)
C	920 (36.2)	955 (37.6)	←	1010 (39.8)
D	160 (6.5)	200 (7.9)	←	←
E	890 (35.0)	935 (36.8)	←	←
F	R1800 (70.9)	R1960 (77.2)	R1980 (78.0)	R2130 (83.9)
G	1695 (66.7)	1880 (74.0)	1890 (74.4)	2000 (78.7)
H	2120 (83.4)	←	←	2165 (85.2)
I	145 (5.7)	125 (4.9)	130 (5.1)	135 (5.3)
J	40 (1.6)	←	←	45 (1.8)
K	2160 (85.0)	2180 (85.8)	←	2275 (89.6)
L	800 (31.5)	1000 (39.4)	←	←
M	410 (16.1)	420 (16.5)	←	485 (19.1)
N	1360 (53.5)	1505 (59.3)	←	1650 (65.0)
O	2877 (113.3)	3235 (127.4)	3255 (128.1)	3480 (137.0)
P	40 %	45 %	←	70 %
Q	89 %	87 %	77 %	73 %

SST LIST

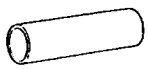
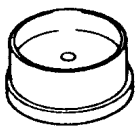
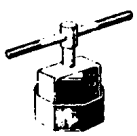
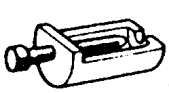
Illustration	Part No.	Part name	Section
	09201-76004-71 (09201-56010)	Valve stem oil seal replacer	7
	09223-76002-71 (09223-15030)	Oil seal and bearing replacer	9
	09308-76001-71 (09308-00010)	Oil seal puller	8 9
	09309-76004-71 (09309-37010)	Transmission bearing replacer	7
	09316-76008-71 (09316-60011)	Transmission & transfer bearing replacer	7
	09509-76002-71 (09509-55020)	Rear wheel bearing nut wrench	9
	09519-76001-71 (09519-25010)	Rear axle hub bearing replacer	9
	09556-76001-71 (09556-22010)	Drive pinion front bearing remover	8
	09608-76003-71 (09608-04031)	Front hub inner bearing cone replacer	7 8
	09610-76002-71 (09610-20012)	Pitman arm puller	10

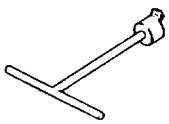
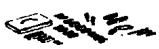
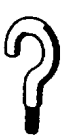
Illustration	Part No.	Part name	Section
	09717-76001-71 (09717-20010)	Brake shoe return spring remover	12
	09718-76001-71 (09718-20010)	Brake shoe return spring replacer	12
	09950-76014-71 (09950-40011)	Puller "B" set	7 8 9 10 15
	09950-76001-71 (09950-50010)	Puller "C" set	7 11
	09550-76018-71 (09950-60010)	Replacer set	7 8 9 10
	09950-76019-71 (09950-60020)	Replacer set No.2	10
	09950-76020-71 (09950-70010)	Handle set	7 8 9 10
	09010-10260-71	Motor hook	7
	09010-13200-71	Motor hook (Use 2 pieces)	7
	09240-13200-71	MCS-Ⅱ check sub-harness	4

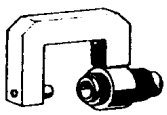
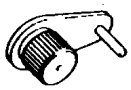
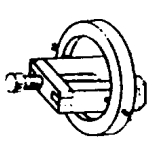
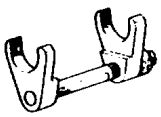
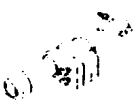
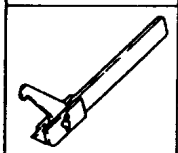
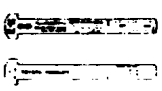
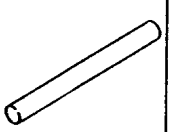
Illustration	Part No.	Part name	Section
	09240-23400-71	IC clip	4
	09310-22000-71	Reamer bolt remover	8
	09330-13200-71	Input gear lock plate	8
	09340-10410-71	Front axle hub oil seal replacer	8
	09360-10410-71	Front axle bracket set bolt replacer	8
	09370-10170-71	Front axle bearing replacer	10
	09370-10410-71	Front axle bearing replacer	8
	09370-20270-71	Drive pinion bearing replacer	10
	09380-41800-71	HST motor bearing puller	7
	09410-30200-71	Rear axle inner bearing replacer	8

Illustration	Part No.	Part name	Section
	09510-31960-71	Brake hold down spring remover & replacer	12
	09610-10160-71	Oil control valve spring remover & replacer	18
	09610-22000-71	Inner mast stopper ASSY	15 16
	09620-10100-71	Cylinder cap remover & replacer	10 16
	09631-22000-71	Wear scale chain	15
	09700-30200-71	Spring pin tool remover	10
	09810-20172-71	Joint pin remover	15 16
	25009-13201-71	Hanger	3

SERVICE STANDARDS LIST

BATTERY

Item		All Models
Specific gravity full discharge		1.280 (at 20°C (68°F))
Specific gravity at the end of discharge		1.150 (at 20°C (68°F))
Final discharge voltage	80 V model	68 V
	72 V model	61 V
Insulation resistance		1 MΩ or more

CONTROLLER

⊕ and ⊖ represent the positive (red) probe and negative (black) probe of the circuit tester.

Item			FBMF 16	FBMF 20-25	FBMF 30
Controller					
CPU board & DC-CD board			See page 3-8		
Display			See page 3-29		
EPS controller			See page 3-15		
F1 (Drive fuse)	A		225	325	350
F2 (Pump fuse)	A		200		225
F3 (Power steering fuse)	A		Up to 1999.8 : 60, From 1999.9 : 40		
F4 (Lamp fuse)	A		10		
F5 (Control circuit fuse)	A		10		
F6 (Power supply)	A		10		
TM·TMP continuity (Tester range Ω × 1 K)	Ω	D ⊖ —— S ⊕	∞		
		D ⊕ —— S ⊖	∞		
		D ⊖ —— G ⊕	∞		
		D ⊕ —— G ⊖	Continuity		
		G ⊖ —— S ⊕	Continuity		
		G ⊕ —— S ⊖	∞		
TG continuity (Tester range Ω × 1 K)	Ω	B ⊖ —— C ⊕	Continuity		
		B ⊕ —— C ⊖	∞		
		C ⊖ —— E ⊕	∞		
		C ⊕ —— E ⊖	Continuity		
DAD DAP continuity (Tester range Ω × 1 K)	KΩ	Forward	Approx. 6		
		Reverse	∞		
DF1 continuity (Tester range Ω × 1 K)	KΩ	Forward	Approx. 3		
		Reverse	∞		
DF2·DF3 continuity (Tester range Ω × 1 K)	KΩ	Forward	Approx. 6		
		Reverse	∞		

Item			FBMF 16	FBMF 20·25	FBMF 30
Controller					
CAD·CAP continuity (Tester range Ω × 1 K) Ω			When the tester probes are brought into contact with the CAD terminals, the pointer initially deflects, then gradually reterns until it finally indicates ∞. (As CAD is charged by the current from the tester.)		
RAD·RG continuity (Tester range Ω × 1) Ω			Approx. 1.5		
RAP continuity (Tester range Ω × 1) Ω			Approx. 25		
MF·MR·MG·MB coil resistance (Tester range Ω × 1) Ω	MF·MR·MG		35 (20°C) (68°F)		
	MB		20 (20°C) (68°F)		
OCL value (Traveling circuit) A			380 ± 20		440 ± 25
Tightening Torque					**N·m (kgf-cm) [ft-lbf]**
TM·TMP	For harness set	M5	1.47 ~ 1.96 (15 ~ 20) [1.09 ~ 1.45]		
		M4	0.98 ~ 1.47 (10 ~ 15) [0.72 ~ 1.09]		
	For mounting	M5	2.45 ~ 2.94 (25 ~ 30) [1.81 ~ 2.17]		
DF1	For harness set	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]		
	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]		
DF2·3	For harness set	M5	1.47 ~ 1.96 (15 ~ 20) [1.09 ~ 1.45]		
	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]		
DG	For main terminal	M6	2.16 ~ 2.75 (22 ~ 28) [1.59 ~ 2.03]		
	For mounting	M20	21.28 ~ 21.87 (217 ~ 223) [15.70 ~ 16.13]		
DAD·DAP	For mounting	M6	2.45 ~ 3.43 (25 ~ 35) [1.81 ~ 2.53]		
TG	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]		
Heat sink	For mounting	M5	1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]		
Terminal plate set bolt, nut and screw		M8	9.31 ~ 10.3 (95 ~ 105) [6.87 ~ 7.60]		
EPS Controller					
TM_{PS} continuity Ω (Tester range Ω × 1 K)	C2E1 ⊖ — E2 ⊕ C2E1 ⊕ — E2 ⊖		∞ Continuity		
	G2 ⊖ —— E2 ⊕ G2 ⊕ —— E2 ⊖		∞ ∞		
DF4 continuity Ω (Tester range Ω × 1 K)	C2E1 ⊖ — C1 ⊕ C2E1 ⊕ — C1 ⊖		Continuity ∞		
Tightening Torque					**N·m (kgf-cm) [ft-lbf]**
M3			0.49 ~ 0.88 (5 ~ 9) [0.36 ~ 0.65]		
M4			0.98 ~ 1.96 (10 ~ 20) [0.72 ~ 1.45]		
M5			1.96 ~ 2.94 (20 ~ 30) [1.45 ~ 2.17]		

Accelerator Potentiometer		
Gap between accelerator arm and arm bracket	1.0 mm (0.039 in)	Switch OFF
	2.0 mm (0.079 in)	Switch ON
Tightening Torque		**N·m (kgf-cm) [ft-lbf]**
Set screw		1.57 ~ 2.35 (16 ~ 24) [1.16 ~ 1.74]
Regenerative Brake Switch		
Within 0 ~ 5 mm (0 ~ 0.20 in) from end of pedal play		Switch ON
Material Handling Lever Switch		
Within 10 ~ 25 mm (0.39 ~ 0.98 in) from end of lever play		Switch ON
Direction Switch		

Item	All Models		
Inspection point \ Lever position	Neutral	Forward	Reverse
DS_F	∞ Ω	0 Ω	∞ Ω
DS_R	∞ Ω	∞ Ω	0 Ω
DS_{FO}	∞ Ω	0 Ω	∞ Ω
DS_{BU}	∞ Ω	∞ Ω	0 Ω

MOTORS

Item			FBMF 16	FBMF 20·25	FBMF 30
Drive Motor					
Armature coil insulation resistance			1 MΩ or more		
Commutator outside diameter	mm (in)	Standard	115 (4.53)	150 (5.91)	
		Limit	112 (4.41)	147 (5.79)	
Undercut	mm (in)	Standard	1.0 (0.039)		
		Limit	0.5 (0.020)		
Field coil conduction (Tester range Ω × 1)	Ω	E —— F	0		
Field coil insulation resistance		Field —— E / F	1 MΩ or more		
Brush length	mm (in)	Standard	34 (1.34)		
		Limit	13 (0.51)		
Brush pressure	N (kgf) [lbf]		13.24 (1.35) ± 10% [2.98]	15.69 (1.60) ± 10% [3.53]	
Brush holder insulation resistance			1 MΩ or more		

Item			FBMF 16	FBMF 20·25	FBMF 30
Pump Motor					
Armature coil insulation resistance			1 MΩ or more		
Commutator outside diameter	mm (in)	Standard	105 (4.13)		
		Limit	102 (4.02)		
Undercut	mm (in)	Standard	1.0 (0.039)		
		Limit	0.5 (0.020)		
Field coil conduction (Tester range Ω × 1)	Ω	Field coil end — F	0		
Field coil insulation resistance	Field — A, F		1 MΩ or more		
Brush length	mm (in)	Standard	34 (1.34)		
		Limit	13 (0.51)		
Brush pressure	N (kgf) [lbf]		13.24 (1.35) ±10% [2.98]	10.10 (1.03) ±10% [2.27]	
Brush holder insulation resistance			1 MΩ or more		
Power Steering Motor					
Armature coil insulation resistance			1 MΩ or more		
Commutator outside diameter	mm (in)	Standard	50 (1.97)		
		Limit	45 (1.77)		
Undercut	mm (in)	Standard	0.8 (0.031)		
		Limit	0.3 (0.012)		
Brush length	mm (in)	Standard	25 (0.98)		
		Limit	Up to 1999.8 : 14 (0.55), From 1999.9 : 15 (0.59)		
Brush pressure	N (kgf) [lbf]	Standard	Up to 1999.8 : 5.59 (0.57) [1.26], From 1999.9 : 4.7 (0.48) [1.06]		
		Limit	Up to 1999.8 : 2.74 (0.28) [0.62], From 1999.9 : 4.25 (0.433) [0.955]		
Brush holder insulation resistance			1 MΩ or more		

DRIVE UNIT

Item		All Models
Spider outside diameter mm (in)	Standard	22.00 (0.8661)
	Limit	21.75 (0.8563)
Differential gear backlash mm (in)		0.2 ~ 0.3 (0.0079 ~ 0.0118)
Tightening Torque		**N·m (kgf-cm) [ft-lbf]**
Differential case		44.1 ~ 53.9 (450 ~ 550) [32.6 ~ 39.8]
Ring gear		127 ~ 177 (1300 ~ 1800) [94 ~ 130]
Front axle housing		73.5 ~ 108 (750 ~ 1100) [54.3 ~ 79.6]
Drive unit cap		73.5 ~ 108 (750 ~ 1100) [54.3 ~ 79.6]
Drive gear lock nut		167 ~ 226 (1700 ~ 2300) [123 ~ 166]

FRONT AXLE

Item			FBMF 16	FBMF 20·25	FBMF 30
Tire					
Tire inflating pressure kPa (kgf/cm²) [psi]	Tire Size	21×8-9-14PR 6.50-10-12PR	883 (9.0) [128]	—	—
		23×9-10-18PR	—	883 (9.0) [128]	—
		28×9-15-14PR	—	—	785 (8.0) [114]
Front Axle					
Hub starting force N (kgf) [lbf]			24.5 ~ 44.1 (2.5 ~ 4.5) [18.1 ~ 32.6]		
Tightening Torque					**N·m (kgf-cm) [ft-lbf]**
Brake drum			68.65 ~ 88.26 (700 ~ 900) [50.65 ~ 86.82]	78.45 ~ 107.87 (800 ~ 1100) [57.88 ~ 79.59]	168.71 ~ 205.94 (1700 ~ 2100) [123.00 ~ 151.94]
Hub bearing nut stopper bolt			14.7 ~ 21.6 (150 ~ 220) [10.9 ~ 15.9]		
Front axle shaft			—	68.65 ~ 88.26 (700 ~ 900) [50.65 ~ 86.82]	98.07 ~ 127.49 (1100 ~ 2000) [72.35 ~ 94.06]
Front axle bracket			157 ~ 216 (1600 ~ 2200) [116 ~ 159]		
Hub nut			176.52 ~ 392.27 (1800 ~ 4000) [130.23 ~ 289.40]	107.87 ~ 196.13 (1100 ~ 2000) [79.59 ~ 144.70]	294.20 ~ 588.40 (3000 ~ 6000) [217.05 ~ 434.10]

REAR AXLE (Up to May 1999)

Item			FBMF 16	FBMF 20·25	FBMF 30
Tire					
Tire inflating pressure kPa (kgf/cm²) [psi]	Tire Size	500-8-8PR	785 (8.0) [114]	—	—
		18 × 7-8-16PR	—	Devided: 690 (7.0) [100] Sidering: 880 (9.0) [128]	880 (9.0) [128]
Rear Axle					
Standard clearance of rear axle front and rear mm (in)			0.5 (0.020) or less		
King pin outside diameter mm (in)		Standard	28.0 (1.102)		
		Limit	27.8 (1.094)		
Support pin bush wear limit mm (in)			52.0 (2.047)		
Rear axle hub starting force (at hub bolt) N (kgf) [lbf]			14.7 ~ 39.2 (1.5 ~ 4.0) [3.3 ~ 8.8]	14.7 ~ 44.1 (1.5 ~ 4.5) [3.3 ~ 9.9]	
Steering knuckle starting force N (kgf) [lbf]			29.4 ~ 49.0 (3.0 ~ 5.0) [6.6 ~ 11.0]		
Toe-in mm (in)			0 (0)		
Cylinder bore mm (in)		Standard	75.00 (2.9528)		
		Limit	75.35 (2.9665)		
Piston rod outside diameter mm (in)		Standard	50.00 (1.9685)		
		Limit	49.92 (1.19654)		
Piston rod bend mm (in)			0.5 (0.020)		

REAR AXLE (From June 1999)

Rear Axle ASSY			
Rear axle ASSY front to rear clearance mm (in)		Standard	0.7 (0.028) or less
Rear axle center pin bushing inside diameter mm (in)		Limit	52.0 (2.047)
Rear Axle Hub and Steering Knuckle			
Rear axle hub starting force (at hub bolt) N (kgf) [lbf]	FBMF16	Standard	15 ~ 39 (1.5 ~ 4.0) [3.3 ~ 8.8]
	FBMF20·25·30	Standard	15 ~ 44 (1.5 ~ 4.5) [3.3 ~ 9.9]
King pin outside diameter mm (in)		Limit	27.8 (1.094)
Steering knuckle starting force (at front end of knuckle) N (kgf) [lbf]		Standard	19.3 (2.0) [4.4] or less
Rear Axle Cylinder			
Rear axle cylinder piston rod outside diameter mm (in)		Limit	49.92 (1.9654)
Rear axle cylinder piston rod bend mm (in)		Limit	0.5 (0.02)
Rear axle cylinder inside diameter mm (in)		Limit	76.35 (3.0059)

REAR AXLE (From June 1999)

Rear Wheel Alignment				
Toe-in mm (in)			Standard	0 ± 4 (0 ± 0.16)
Tightening Torque				**N·m (kgf-cm) [ft-lbf]**
Axle bracket cap set bolt			Standard	117.7 ~ 166.7 (1200 ~ 1700) [86.82 ~ 123.0]
King pin lock bolt and lock nut			Standard	44.1 ~ 53.9 (450 ~ 550) [32.6 ~ 39.8]
Divided rim bolt set nut		FBMF16	Standard	29.4 ~ 44.1 (300 ~ 450) [21.7 ~ 32.6]
		FBMF20·25·30	Standard	49.0 ~ 68.4 (500 ~ 700) [36.2 ~ 50.7]
Rear axle cylinder rod guide set nut			Standard	88 ~ 118 (900 ~ 1200) [65.1 ~ 86.8]
Rear axle cylinder set bolt			Standard	166.7 ~ 215.8 (1700 ~ 2200) [123.00 ~ 159.17]
Tie rod end pin plate set bolt			Standard	49.1 ~ 68.7 (500 ~ 700) [36.2 ~ 50.6]
Hub nut	FBMF16	Divided rim	Standard	88.3 ~ 157.0 (900 ~ 1600) [65.1 ~ 115.8]
		Side ring rim	Standard	88.3 ~ 157.0 (900 ~ 1600) [65.1 ~ 115.8]
	FBMF20·25	Divided rim	Standard	117.7 ~ 196.1 (1200 ~ 2000) [86.82 ~ 144.7]
		Side ring rim	Standard	117.7 ~ 196.1 (1200 ~ 2000) [86.82 ~ 144.7]
	FBMF30	Side ring rim	Standard	88.3 ~ 157.0 (900 ~ 1600) [65.12 ~ 115.8]

STEERING

Item		FBMF 16	FBMF 20·25	FBMF 30
Hydrostatic Steering Valve ASSY				
Relief valve set pressure (Up to October 1998) kPa (kgf/cm²) [psi]		5390 ~ 6370 (55 ~ 65) [780 ~ 920]	7350 ~ 8340 (75 ~ 85) [1070 ~ 1210]	
Relief valve pressure (From November 1998) kPa (kgf/cm²) [psi]		7850 ± 49 (80 ± 5) [1140 ± 70]		
Tightening Torque				**N·m (kgf-cm) [ft-lbf]**
Steering universal joint set bolt		17.65 ~ 24.52 (180 ~ 250) [13.02 ~ 18.09]		
Mast jacket set nut		34.32 ~ 53.94 (350 ~ 550) [25.32 ~ 39.79]		
Steering wheel set nut		19.61 ~ 29.42 (200 ~ 300) [14.47 ~ 21.71]		
Steering valve	Relief valve plug	49.0 ~ 58.8 (500 ~ 600) [36.2 ~ 43.4]		
	End cover set bolt	24.52 ~ 29.42 (250 ~ 300) [13.02 ~ 21.71]		
	Mounting plate	19.6 ~ 24.5 (200 ~ 250) [14.5 ~ 18.1]		
	Check valve	9.8 ~ 13.7 (100 ~ 140) [7.2 ~ 10.1]		
	Relief valve ASSY	49.0 ~ 58.8 (500 ~ 600) [36.2 ~ 43.4]		

BRAKE

Item		FBMF 16	FBMF 20·25	FBMF 30
Front Brake				
Clearance between wheel cylinder and piston mm (in)	Limit	0.125 (0.00492)		0.145 (0.00571)
Brake drum inside diameter mm (in)	Standard	254.0 (10.000)	279.4 (11.000)	310 (12.20)
	Limit	256.0 (10.079)	281.4 (11.079)	312 (12.28)
Brake lining thickness mm (in)	Standard	4.9 (0.193)	5.1 (0.201)	7.0 (0.276)
	Limit	1.0 (0.039)		2.0 (0.08)
Brake shoe return spring free length mm (in)		102 (4.02)	106 (4.17)	
Adjuster spring free length mm (in)		79.0 (3.110)	98.4 (3.874)	86.0 (3.386)
Strut spring free length mm (in)		20.0 (0.787)	29.8 (1.173)	23.0 (0.906)
Shoe hold down spring free length mm (in)		25.7 (1.012)	35.9 (1.413)	31.3 (1.232)
Tightening Torque				**N·m (kgf-cm) [ft-lbf]**
Wheel cylinder set bolt		7.85 ~ 11.77 (80 ~ 120) [5.79 ~ 8.68]	17.65 ~ 26.48 (180 ~ 270) [13.62 ~ 19.53]	14.71 ~ 19.61 (150 ~ 200) [10.85 ~ 14.47]
Backing plate self lock nut		117.68 ~ 137.29 (1200 ~ 1400) [86.82 ~ 101.29]		
Master Cylinder				
End cap tightening torque N·m (kgf-cm) [ft-lbf]		196 ~ 275 (2000 ~ 2800) [145 ~ 203]		
Parking Brake				
Number of parking brake lever notches		3 ~ 4 notches Operating force 147N (15 kgf) [33 lbf]		
Brake Pedal				
Pedal height (from toe-boad to pedal top surface at center) mm (in)	Without pad	130 ~ 135 (5.12 ~ 5.31)		
	With pad	134 ~ 139 (5.28 ~ 5.47)		
Pedal play mm (in)		3 ~ 7 (0.12 ~ 0.28)		
Depressed pedal height mm (in)		60 (2.36) or more		

BODY

Item	All models
Combination Meter	
Tightening Torque	**N·m (kgf-cm) [ft-lbf]**
Window plate set screw	34.3 ~ 39.2 (350 ~ 400) [25.3 ~ 28.9]
Panel assy set screw	34.3 ~ 39.2 (350 ~ 400) [25.3 ~ 28.9]
Combination meter board set screw	68.6 ~ 78.5 (700 ~ 800) [50.6 ~ 57.9]

MATERIAL HANDLING SYSTEM

Item	FBMF 16	FBMF 20·25	FBMF 30
Natural Drop Test			
Natural drop mm (in)	90 (3.54) or less		
Natural Forward Tilt Test			
Natural forward tilt mm (in)	30 (1.18) or less	45 (1.77) or less	
Oil Leak Test			
Lift cylinder oil leak amount cc (cu-in)	16 (0.98) or less		
Tilt cylinder oil leak amount (total for lift and tilt) cc (cu-in)	34 (2.07) or less		

MAST

Item			All models
Mast Adjustment (V mast)			
Mast rollers	Inner mast roller clearance mm (in)		0 ~ 0.8 (0 ~ 0.031)
	Outer mast roller clearance mm (in)		0 ~ 0.8 (0 ~ 0.031)
Lift bracket rollers	Middle and lower lift roller clearance mm (in)		0 ~ 0.8 (0 ~ 0.031)
	Side roller clearance mm (in)		0 ~ 0.6 (0 ~ 0.024)
Mast strip to inner mast clearance mm (in)			0.5 ~ 1.0 (0.020 ~ 0.039)
Mast strip thickness mm (in)		Limit	1.5 (0.059)
Fork			
Fork front end misalignment mm (in)		Limit	10 (0.39)
Tightening Torque			**N·m (kgf-cm) [ft-lbf]**
Mast support cap set bolt			68.65 ~ 107.87 (700 ~ 1100) [50.65 ~ 79.59]
Back rest set bolt			99.54 ~ 184.86 (1015 ~ 1885) [73.44 ~ 136.38]
Chain adjusting nut			49.03 ~ 78.45 (500 ~ 800) [36.18 ~ 57.88]

CYLINDERS

Item			FBMF 16	FBMF 20·25	FBMF 30
Lift Cylinder					
Piston rod outside diameter mm (in)	V FSV	Standard	35 (1.38)	40 (1.57)	45 (1.77)
		Limit	34.92 (1.3748)	39.92 (1.5717)	44.92 (1.7685)
	FV	Standard	32 (1.26)	35 (1.38)	40 (1.57)
		Limit	31.92 (1.2567)	34.92 (1.3748)	39.92 (1.5717)
Lift cylinder bore mm (in)		Standard	45 (1.77)	50 (1.97)	55 (2.17)
		Limit	45.20 (1.7795)	50.20 (1.9764)	55.35 (2.1791)
Front Lift Cylinder (FV·FSV)					
Piston rod outside diameter mm (in)		Standard	70 (2.76)	75 (2.95)	85 (3.35)
		Limit	69.91 (2.7524)	74.91 (2.9492)	84.90 (3.3425)
Lift cylinder bore mm (in)		Standard	85 (3.35)	90 (3.54)	105 (4.13)
		Limit	85.40 (3.3622)	90.40 (3.5591)	105.40 (4.1496)
Tilt Cylinder					
Cylinder bore mm (in)		Standard	70.0 (2.756)		
		Limit	70.35 (2.7697)		
Piston rod outside diameter mm (in)		Standard	30.0 (1.181)		
		Limit	29.92 (1.1780)		
Piston rod bend mm (in)		Limit	1.0 (0.039)		

Tightenig Torque	**N·m (kgf-cm) [ft-lbf]**
Lift cylinder cover	343.23 ~ 441.30 (3500 ~ 4500) [253.23 ~ 325.58]
Flow regulator valve	58.84 ~ 68.65 (600 ~ 700) [43.41 ~ 50.65]
Safety down valve	29.42 ~ 39.23 (300 ~ 400) [21.71 ~ 28.94]
Front lift cylinder rod guide	343.23 ~ 441.30 (3500 ~ 4500) [253.23 ~ 325.58]
Tilt cylinder piston lock nut	260 ~ 350 (2650 ~ 3570) [191.72 ~ 258.29]
Tilt cylinder rod joint set bolt	65 ~ 110 (660 ~ 1120) [47.75 ~ 81.03]
Tilt cylinder joint rock nut	360 (3700) [267]
Tilt cylinder rod guide	260 ~ 350 (2650 ~ 3570) [191.72 ~ 258.29]

OIL PUMP

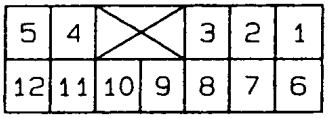
Item		FBMF 16	FBMF 20·25	FBMF 30
Oil Pump ASSY				
Side bush inside diameter limit	mm (in)	—	19.123 (0.75287)	—
Side bush axial length limit	mm (in)	—	14.77 (0.58159)	—
Center bush inside diameter limit	mm (in)	—	19.123 (0.75287)	—
Center bush axial length limit	mm (in)	—	29.68 (1.1685)	—
Gear shaft outside diameter limit	mm (in)	—	18.935 (0.74547)	—
Body inside surface flaw depth limit	mm (in)	0.08 (0.003)	0.1 (0.004)	0.08 (0.003)
Tightening Torque				**N·m (kgf-cm) [ft-lbf]**
Pump cover set bolt		43 ~ 51 (440 ~ 520) [31.8 ~ 37.6]	46.1 ~ 48.1 (4700 ~ 4900) [34.0 ~ 35.5]	43 ~ 51 (440 ~ 520) [31.8 ~ 37.6]

OIL CONTROL VALVE

Item		FBMF 16	FBMF 20·25	FBMF 30
Oil Control Valve				
Lift relief pressure	kPa (kgf/cm²) [psi]	15200 (155) [2200]	17160 (175) [2490]	18140 (185) [2630]
Tilt relief pressure	kPa (kgf/cm²) [psi]	11770 (120) [1710]	14710 (150) [2130]	
Tightening Torque				**N·m (kgf-cm) [ft-lbf]**
Outlet housing		34.3 ~ 44.1 (350 ~ 450) [25.3 ~ 32.6]		

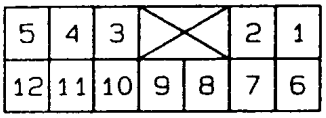
CPU BOARD & DC-CD BOARD CONNECTOR DRAWING
(View from the board connector side)

CN101 (TAB)



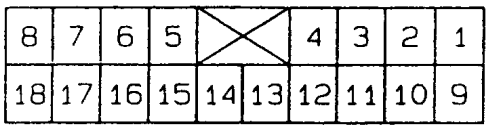
No.	P	No.	P
1	–	7	N2
2	4	8	3
3	2	9	43
4	P2	10	P10
5	1	11	91
6	PIA	12	41

CN102 (TAB)



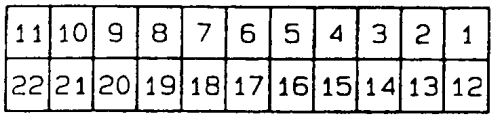
No.	P	No.	P
1	–	7	–
2	6	8	10 (SDD)
3	12 (SDD)	9	10 (SDP)
4	12 (SDP)	10	11 (SDD)
5	–	11	11 (SDP)
6	18	12	–

CN103 (TAB)



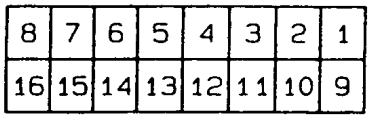
No.	P	No.	P
1	21	10	27
2	25	11	26
3	24	12	22
4	23	13	28
5	N2	14	29
6	–	15	–
7	15	16	13
8	14	17	–
9	20	18	N2

CN104 (TAB)



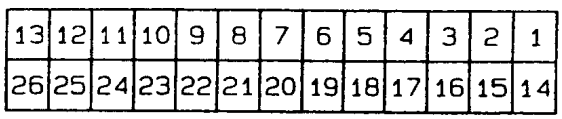
No.	P	No.	P
1	15	12	28
2	–	13	–
3	21	14	–
4	22	15	29
5	27	16	–
6	23	17	–
7	24	18	13
8	26	19	14
9	25	20	20
10	N2	21	–
11	–	22	N2

CN105 (TAB)



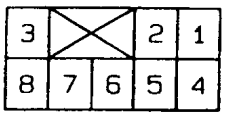
No.	P	No.	P
1	75	9	76
2	36	10	35
3	31	11	30
4	74 (CSP)	12	74 (CSD)
5	73 (CSP)	13	72
6	73 (CSD)	14	71
7	37	15	38
8	32	16	33

CN106 (TAB)



No.	P	No.	P
1	51	14	51 (brake)
2	84	15	53
3	83	16	52
4	82	17	–
5	81	18	55
6	46	19	60
7	45	20	61
8	64	21	–
9	65	22	63
10	77	23	66
11	80	24	–
12	–	25	–
13	51 (accel)	26	–

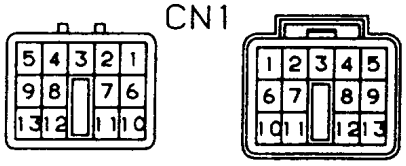
CN107 (TAB)



No.	P	No.	P
1	141	5	143
2	142	6	17
3	–	7	–
4	144	8	16

CONNECTING DIAGRAM

CN1



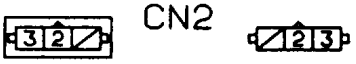
TAB

NO	P	C	J
1	16	R	CN120-9
2	17	BR	CN120-19
3	104	G-R	CN120-10
4	144	R-G	CN120-12
5	141	R-W	CN120-2
6	77	G-Y	CN2-3
7	51	R-L	CN2-2
8	143	R-Y	CN120-1
9	142	R-B	CN120-11
10	151	G-W	CN120-8
11			
12	43	B-Y	CN120-6
13	N1	W-B	CN120-20

REC

NO	P	C	J
1	16	R	J1
2	17	BR	J2
3	104	G-R	J3
4	144	R-G	CN107-4
5	141	R-W	CN107-1
6	77	G-Y	CN106-10
7	51	R-L	J4, CN106-1
8	143	R-Y	CN107-5
9	142	R-B	CN107-2
10	151	G-W	CN27-4
11			
12	43	B-Y	CN100-2
13	N1	W-B	J6

CN2



TAB

NO	P	C	J
2	51	R-L	CN1-7
3	77	G-Y	CN1-6

REC

NO	P	C	J
2	51	R-L	SW_{SC}
3	77	G-Y	SW_{SC}

CN3

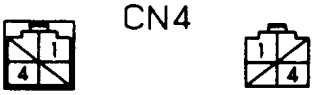
TAB

NO	P	C	J
1	101	R	B
2	104	G	T
3	102	R-G	HS
4	107	R-Y	HM

REC

NO	P	C	J
1	101	R	CN35-1
2	104	G-R	J3
3	102	R-G	CN13-3, CN17-3
4	107	R-B	CN16-1, CN33-1

CN4



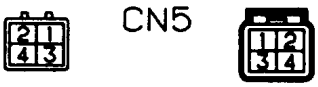
TAB

NO	P	C	J
1	41	-	AM
4	43	-	IG

REC

NO	P	C	J
1	41	Y	CN100-1, SA
4	43	B-Y	J6, SA

CN5



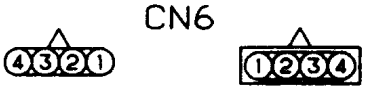
TAB

NO	P	C	J
1	52	GR	CN6-3
2	53	R-B	CN6-4
3	51	R-L	CN6-1
4	64	R-Y	CN6-2

REC

NO	P	C	J
1	52	GR	CN106-16
2	53	R-B	J7
3	51	R-L	CN106-13
4	64	R-Y	CN106-8

CN6



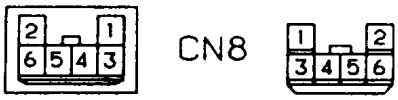
TAB

NO	P	C	J
1	51	-	E2
2	64	-	IDL
3	52	-	VTA
4	53	-	VC

REC

NO	P	C	J
1	51	R-L	CN5-3
2	64	R-Y	CN5-4
3	52	GR	CN5-1
4	53	R-B	CN5-2

CN8



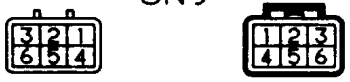
TAB

NO	P	C	J
1	41	GY	$SW_{H(+)}$
2	48	WB	$SW_{H(-)}$
3	43	GW	SWF(B)
4	108	G	SWF(R)
5	109	GR	SWF(L)
6			

REC

NO	P	C	J
1	41	Y	J13
2	48	P	H
3	43	B-Y	J5
4	108	R-Y	CN31-6, CN13-6
5	109	G-Y	CN29-6, CN17-6
6			

CN9



TAB

NO	P	C	J
1	51	O	DSF, DSR
2	120	B	DSFO
3	103	G	DSBU
4	45	W-O	DSF
5	46	W-BR	DSR
6	43	R	DSFO, DSBU

REC

NO	P	C	J
1	51	R-L	J4
2	120	Y-R	CN33-4
3	103	R-W	J9
4	45	W	CN106-7
5	46	G	CN106-6
6	43	B-Y	J5

CN10

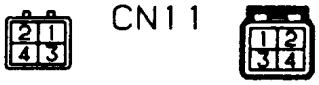
TAB

NO	P	C	J
1	55	G	VRAP
2	53	B-R	VRAP
3	51	O	VRAP

REC

NO	P	C	J
1	55	R-W	CN106-18
2	53	R-B	J7
3	51	R-L	J4

CN11



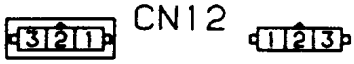
TAB

NO	P	C	J
1	60	G-W	LS_L
2	61	G-R	LS_T
3	63	G-B	LS_{ATT}
4	51	R-L	NO

REC

NO	P	C	J
1	60	G-W	CN106-19
2	61	G-R	CN106-20
3	63	G-B	CN106-22
4	51	R-L	J4

CN12



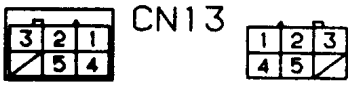
TAB

NO	P	C	J
1	N1	B	FRY
2	110	GR	FRY
3	43	R	FRY

REC

NO	P	C	J
1	N1	W-B	J6
2	110	GR	J8
3	43	B-Y	J5

CN13



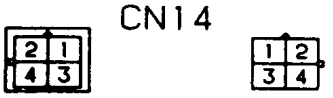
TAB

NO	P	C	J
1	N1	W-B	J11
2	104	G-R	CN14-4
3	102	R-G	LH
4	108	G-Y	CN14-1
5	110	GR	CN14-2

REC

NO	P	C	J
1	N1	W-B	J6
2	104	G-R	J3
3	102	R-G	CN3-3
4	108	R-Y	CN8-4
5	110	GR	J8

CN14



TAB

NO	P	C	J
1	108	G-W	LF-R
2	110	Y	LF-R
3	N1	W-B	LC-R
4	104	R-W	LC-R

REC

NO	P	C	J
1	108	G-Y	CN13-4
2	110	GR	CN13-5
3	N1	W-B	J11
4	104	G-R	CN13-2

CN15

TAB

NO	P	C	J
1	66	B-W	LS_{PB}
2	51	R-L	LS_{PB}

REC

NO	P	C	J
1	66	B-W	CN106-23
2	51	R-L	J4

CN16

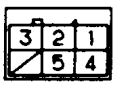
TAB

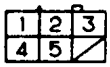
NO	P	C	J
1	107	B	PL+
2	N1	B	PL+

REC

NO	P	C	J
1	107	R-B	CN3-4
2	N1	W-B	J6

CN17





TAB

NO	P	C	J
1	N1	W-B	J12
2	104	G-R	CN18-4
3	102	R-G	LH
4	109	G-Y	CN18-1
5	110	GR	CN18-2

REC

NO	P	C	J
1	N1	W-B	J6
2	104	G-R	J3
3	102	R-G	CN3-3
4	109	G-Y	CN8-5
5	110	GR	J8

CN18

TAB

NO	P	C	J
1	109	G-W	LF-L
2	110	Y	LF-L
3	N1	W-B	LC-L
4	104	R-W	LC-L

REC

NO	P	C	J
1	109	G-Y	CN17-4
2	110	GR	CN17-5
3	N1	W-B	J12
4	104	G-R	CN17-2

CN19

TAB

NO	P	C	J
1	161	G-R	+15V
2	162	G-Y	ST
3	163	G-B	GND

REC

NO	P	C	J
1	161	G-R	CN27-3
2	162	G-Y	CN27-2
3	163	G-B	CN27-5

CN20

TAB

NO	P	C	J
1	67	-	SW_+
2	51	-	SW_-

REC

NO	P	C	J
1	67	P	CN106-25
2	51	R-L	J4

CN21

TAB

NO	P	C	J
1	84	W	SSP2
2	83	B	SSP2

REC

NO	P	C	J
1	84	W-G	CN106-2
2	83	B-R	CN106-3

CN22

TAB

NO	P	C	J
1	82	W	SSP1
2	81	B	SSP1

REC

NO	P	C	J
1	82	W-R	CN106-4
2	81	B-Y	CN106-5

CN23

TAB

NO	P	C	J
1	103	R-W	BZ
2	N1	B	BZ

REC

NO	P	C	J
1	103	R-W	J8 CN42-3
2	N1	W-B	J6 CN41-2

CN25

TAB

NO	P	C	J
1	101	B-Y	LS_{ST}
2	111	Y	LS_{ST}

REC

NO	P	C	J
1	101	R	CN35-1
2	111	R-L	J10

CN26

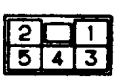
TAB

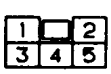
NO	P	C	J
1	65	B-W	LS_0
2	51	R-L	LS_0

REC

NO	P	C	J
1	65	Y-G	CN106-9
2	51	R-L	CN106-14

CN27





TAB

NO	P	C	J
1	43	-	PB_{SPS}
2	162	-	PB_{SPS}
3	161	-	PB_{SPS}
4	151	-	PB_{SPS}
5	163	-	PB_{SPS}

REC

NO	P	C	J
1	43	B-Y	J5
2	162	G-Y	CN19-2
3	161	G-R	CN19-1
4	151	G-W	CN1-10
5	163	G-B	CN19-3

CN28

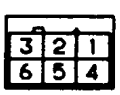
TAB

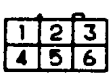
NO	P	C	J
1	43	-	-
2	N1	-	-

REC

NO	P	C	J
1	43	B-Y	J5
2	N1	W-B	CN30-2

CN29





TAB

NO	P	C	J
1	104	R-W	LT-L
2	N1	W-B	GND
3	110	Y	LF-LR
4	111	R-B	LST-L
5	103	R	LBU-L
6	109	G-W	LF-LR

REC

NO	P	C	J
1	104	G-R	J3
2	N1	W-B	J6
3	110	GR	J8
4	111	R-L	J10
5	103	R-W	J9
6	109	G-Y	CN8-5

CN30

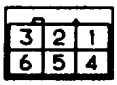
TAB

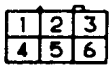
NO	P	C	J
1	43	B-Y	BA
2	N1	W-B	BA

REC

NO	P	C	J
1	43	B-Y	J6 CN100-2
2	N1	W-B	J6 CN28-2

CN31





TAB

NO	P	C	J
1	104	R-W	LT-R
2	N1	W-B	GND
3	110	Y	LF-RR
4	111	R-B	LST-R
5	103	B	LBU-R
6	108	G-W	LF-RR

REC

NO	P	C	J
1	104	G-R	J3
2	N1	W-B	J6
3	110	GR	J8
4	111	R-L	J10
5	103	R-W	J9
6	108	R-Y	CN8-4

CN33

TAB

NO	P	C	J
1	107	R-B	LW
2	N1	W-B	LR. LW
3	103	R-W	LR
4	120	Y-R	LR

REC

NO	P	C	J
1	107	R-B	CN3-4
2	N1	W-B	J6
3	103	R-W	J9
4	120	Y-R	CN9-2

CN35

TAB

NO	P	C	J
1	101	-	F4
2	PO	-	F4. F5
4	41	-	F5

REC

NO	P	C	J
1	101	R	CN3-1. CN25-1
2	PO	B	PO TERMINAL
4	41	Y	J13

CN36

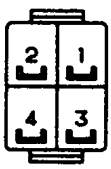
TAB

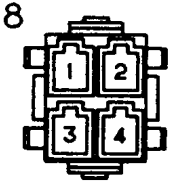
NO	P	C	J
1	18	B	F6
2	P1	R	F6

REC

NO	P	C	J
1	18	R-W	CN100-4
2	P1	R	P1 TERMINAL

CN38





TAB

NO	P	C	J
1	P21	L	CN39-1
2	P22	W	CN39-2
3	P21	R	F3
4	N1	W-B	N1 TERMINAL

REC

NO	P	C	J
1	P21	L	FETC1
2	P22	W	FETC2
3	P21	R	FETC1
4	N1	W-B	RESISTOR

CN39

TAB

NO	P	C	J
1	P21	B	DM_{DS}
2	P22	B	DM_{DS}

REC

NO	P	C	J
1	P21	L	CN38-1
2	P22	W	CN38-2

CN41

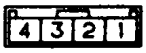
TAB

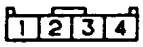
NO	P	C	J
1	125	R-W	BZ
2	N1	B	BZ
3	127	Y	BZ
4	126	W	BZ

REC

NO	P	C	J
1	125	GR	CN42-4
2	N1	W-B	CN23-2
3	127	R-Y	CN42-1
4	126	R-L	CN42-2

CN42





TAB

NO	P	C	J
1	127	BL	SW_{RF}
2	126	BL	SW_{RR}
3	103	BL	SW_{B}
4	125	BL	SW_{RF}

REC

NO	P	C	J
1	127	R-Y	CN41-3
2	126	R-L	CN41-4
3	103	R-W	CN23-1
4	125	GR	CN41-1

CN100

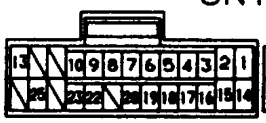
TAB

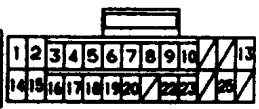
NO	P	C	J
1	41	Y-L	SWK
2	43	R-B	SWK
3	N1	W-B	GND
4	18	BR	B80V

REC

NO	P	C	J
1	41	Y	J13. CN4-1
2	43	B-Y	CN9-1. CN4-12
3	N1	W-B	J6
4	18	R-W	CN36-1

CN106





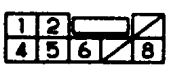
TAB

NO	P	C	J
1	51	-	GND
2	84	-	SS2-
3	83	-	SS2+
4	82	-	SS1-
5	81	-	SS1+
6	46	-	DSF
7	45	-	DSR
8	64	-	LSAC
9	65	-	LSB
10	77	-	SWSC
13	51	-	GND
14	51	-	GND
15	53	-	POT+
16	52	-	POTA
17	57	-	POTB
18	55	-	POTL
19	60	-	LSL
20	61	-	LST
22	63	-	LSAT2
23	66	-	LSPB
25	67	-	SW.

REC

NO	P	C	J
1	51	R-L	J4. CN1-7
2	84	W-G	CN21-1
3	83	B-R	CN21-2
4	82	W-R	CN22-1
5	81	B-Y	CN22-2
6	46	G	CN9-5
7	45	W	CN9-4
8	64	R-Y	CN5-4
9	65	Y-G	CN26-1
10	77	G-Y	CN1-6
13	51	R-L	CN5-3
14	51	R-L	CN26-2
15	53	R-B	J7
16	52	GR	CN5-1
17			
18	55	R-W	CN10-1
19	60	G-W	CN11-1
20	61	G-R	CN11-2
22	63	G-B	CN11-3
23	66	B-W	CN15-1
25	67	P	CN20-1

CN107



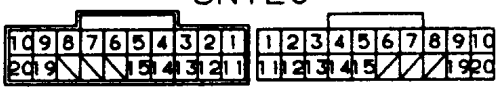
TAB

NO	P	C	J
1	141	-	SMTDA
2	142	-	SDTMA
4	144	-	SMTDK
5	143	-	SDTMK
6	17	-	GND
8	16	-	+30V

REC

NO	P	C	J
1	141	R-W	CN1-5
2	142	R-B	CN1-9
4	144	R-G	CN1-4
5	143	R-Y	CN1-8
6	17	BR	J2
8	16	R	J1

CN120

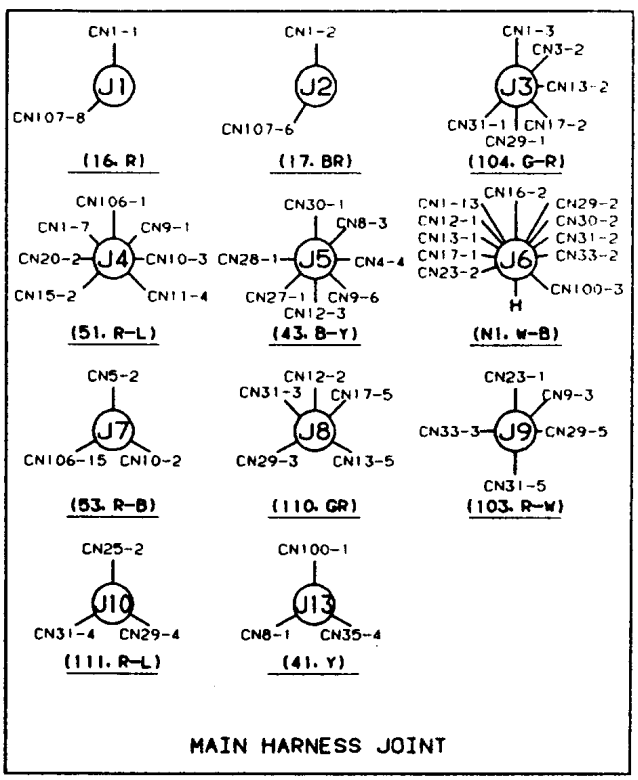


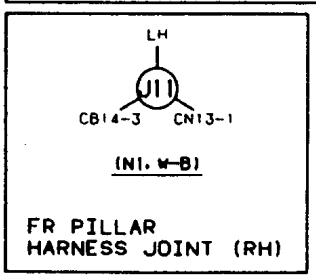
TAB

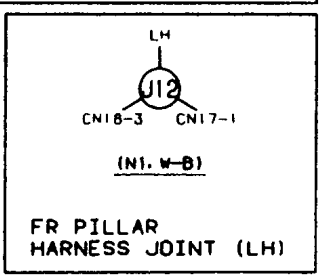
NO	P	C	J
1	143	-	SDTMK
2	141	-	SMTDA
3	136	-	AC
4	131	-	SW1
5	132	-	SW2
6	43	-	+48V
7	152	-	SLL
8	151	-	SPSAL
9	16	-	+30V
10	104	-	BL
11	142	-	SDTMA
12	144	-	SMTDK
13	135	-	CLK
14	134	-	DATA
15	133	-	MSCH
19	17	-	GND(N2)
20	N1	-	GND(N1)

REC

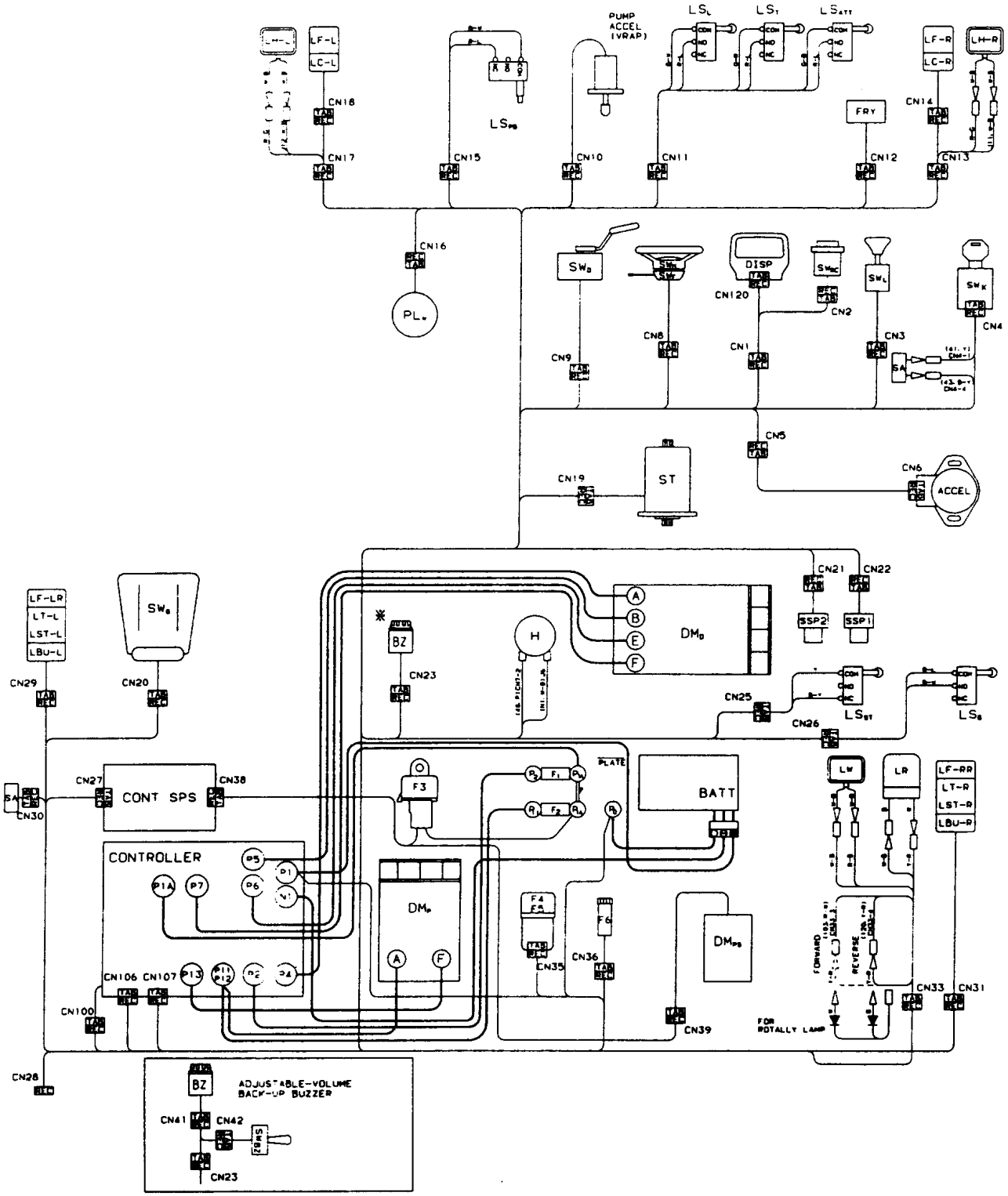
NO	P	C	J
1	143	R-Y	CN1-8
2	141	R-W	CN1-5
3			
4			
5			
6	43	B-Y	CN1-12
7			
8	151	G-W	CN1-10
9	16	R	CN1-1
10	104	G-R	CN1-3
11	142	R-B	CN1-9
12	144	R-G	CN1-4
13			
14			
15			
19	17	BR	CN1-2
20	N1	W-B	CN1-13



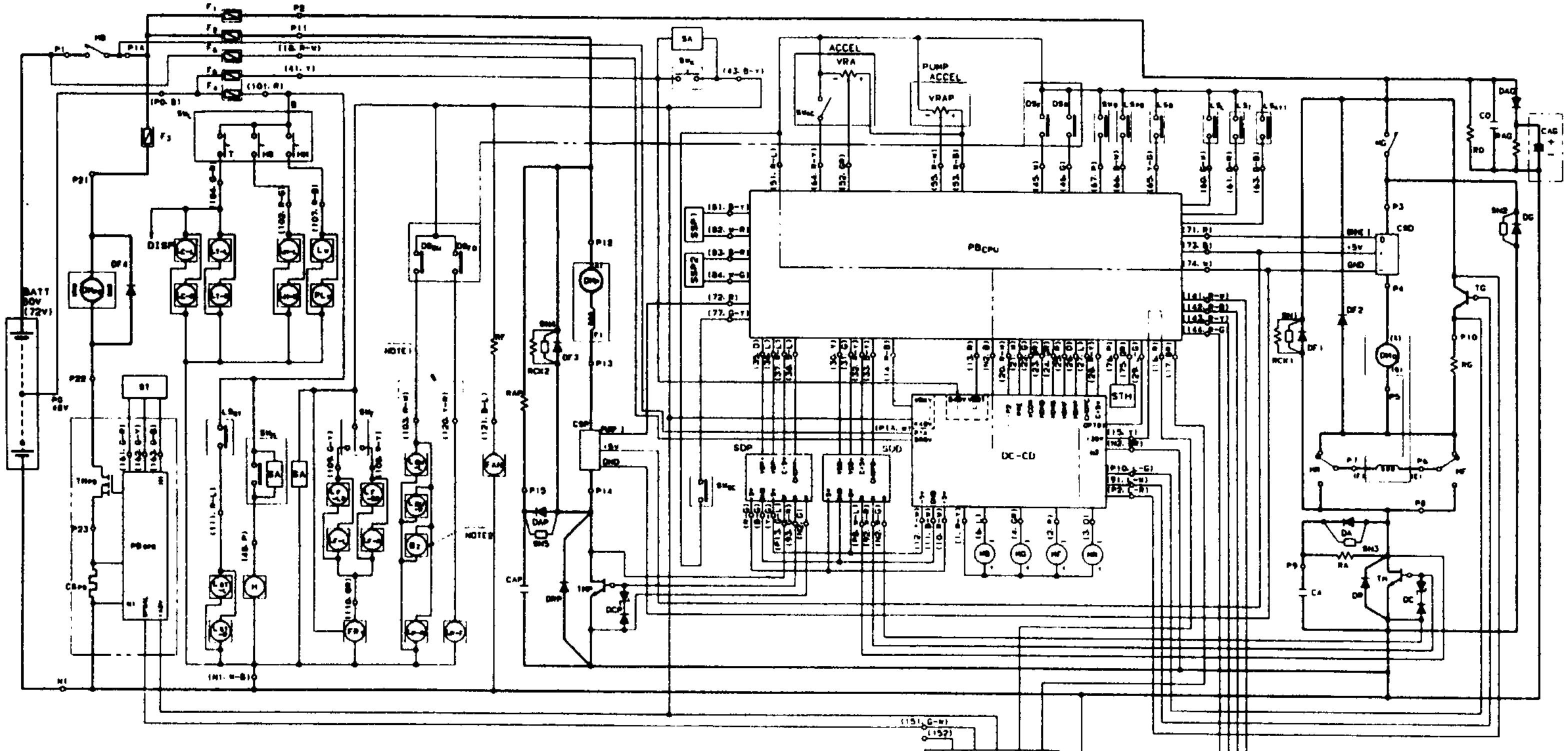


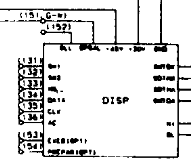


CONNECTING DIAGRAM



WIRING DIAGRAM



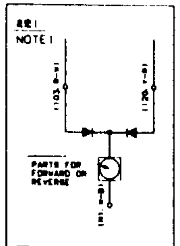


BATT	BATTERY
F1	FUSE. DRIVE
F2	FUSE. PUMP
F3	FUSE. POWER STEERING
F4	FUSE. LAMP
F5	FUSE. CONTROL CIRCUIT
F6	FUSE. POWER SUPPLY
PB_{CPU}	PRINT BOARD. COMPUTER
DC-CD	DC-DC CONVERTER & CONTACTOR DRIVE
PB_{SPS}	PRINT BOARD. SPS
SDD	SIT DRIVER. DRIVE
SDP	SIT DRIVER. PUMP
DISP	DISPLAY
$DM_{D/P}$	MOTOR. DRIVE/PUMP
DM_{PS}	MOTOR. POWER STEERING
TM	TRANSISTOR. MAIN
TMP	TRANSISTER. MAIN. PUMP
TM_{PS}	TRANSISTER. MAIN. POWER STEERING
TG	TRANSISTOR. REGENERATIVE
RA/RAP	RESISTOR. ABSORBER. DRIVE/PUMP
RG	RESISTOR. REGENERATIVE
RF	RESISTOR. FAN

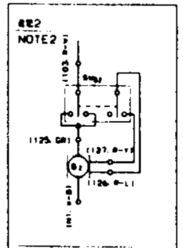
RAG	RESISTOR. ABSORBER. REGENERATIVE
RCK1/2	RESISTOR. CHECK. NO1/2
RO	RESISTOR. OVERALL
VRAD/P	VARI-OHM. ACCEL. DRIVE/PUMP
DF1/2	DIODE. FLY-WHEEL. NO.1/2
DF3/4	DIODE. FLY-WHEEL. NO.3/4
DA/DAP	DIODE. ABSORBER. DRIVE/PUMP
DR/DRP	DIODE. REVERSE. DRIVE/PUMP
DG	DIODE. REGENERATIVE
DAG	DIODE. ABSORBER. REGENERATIVE
DC/DCP	DIODE. CRP. (no arip voltage) DRIVE/PUMP
CA/CAP	CAPACITOR. ABSORBER. DRIVE/PUMP
CO	CAPACITOR. OVERALL
CAG	CAPACITOR. ABSORBER. REGENERATIVE
CSD/P	CURRENT SENSOR. DRIVE/PUMP
CS_{PS}	CURRENT SENSOR. POWER STEERING
SSP1/2	SENSOR. SPEED. NO.1/2
ST	SENSOR. STEERING TORQUE
SLL	SENSOR. LEQUID LEVEL
STM	SENSOR. THERMO
SHA	SENSOR. HANDLE. (steering wheel) ANGLE
STA	SENSOR. TIRE. ANGLE

MF	CONTACTOR. FORWARD
MR	CONTACTOR. REVERSE
MG	CONTACTOR. REGENERATIVE
MB	CONTACTOR. BATTERY
DS_F	DIRECTION SWITCH. FORWARD
DS_R	DIRECTION SWITCH. REVERSE
DS_{FO}	DIRECTION SWITCH. FORWARD OPTIONAL
DS_{BU}	DIRECTION SWITCH. BACK-UP
LS_B	LIMIT SWITCH. BRAKE
LS_L	LIMIT SWITCH. LIFT
LS_T	LIMIT SWITCH. TILT
LS_{ATT}	LIMIT SWITCH. ATTACHMENT
LS_{ST}	LIMIT SWITCH. STOP LAMP
SW_{AC}	SWITCH. ACCEL
SW_S	SWITCH. SEAT
SW_K	SWITCH. KEY
SW_L	SWITCH. LIGHT
SW_F	SWITCH. FLASHER
SW_H	SWITCH. HORN
SW_{SC}	SWITCH. SPEED CONTROL
PL_W	PILOT LAMP. WORKING
L_{H-L}	LAMP. HEAD LH
L_{H-R}	LAMP. HEAD RH
L_{C-L}	LAMP. CLEARANCE LH
L_{C-R}	LAMP. CLEARANCE RH
L_{T-L}	LAMP. TAIL LH
L_{T-R}	LAMP. TAIL RH
L_W	LAMP. WORKING

L_{F-LR}	LAMP. FLASHER LH (REAR)
L_{F-RR}	LAMP. FLASHER RH (REAR)
L_{F-L}	LAMP. FLASHER LH
L_{F-R}	LAMP. FLASHER RH
L_{ST-L}	LAMP. STOP LH
L_{ST-R}	LAMP. STOP RH
L_{R-F}	LAMP. ROTALY FORWARD
L_{R-R}	LAMP. ROTALY REVERSE
L_{BU-L}	LAMP. BACK-UP LH
L_{BU-R}	LAMP. BACK-UP RH
B_Z	BUZZER
H	HORN
FR.	RELAY. FLASHER
SA	SURGE ABSORBER
VP	VALVE. POPPET
FAN	FAN
SN1~5	SNUBBER. NO.1~NO.5



FORWARD OR REVERSE



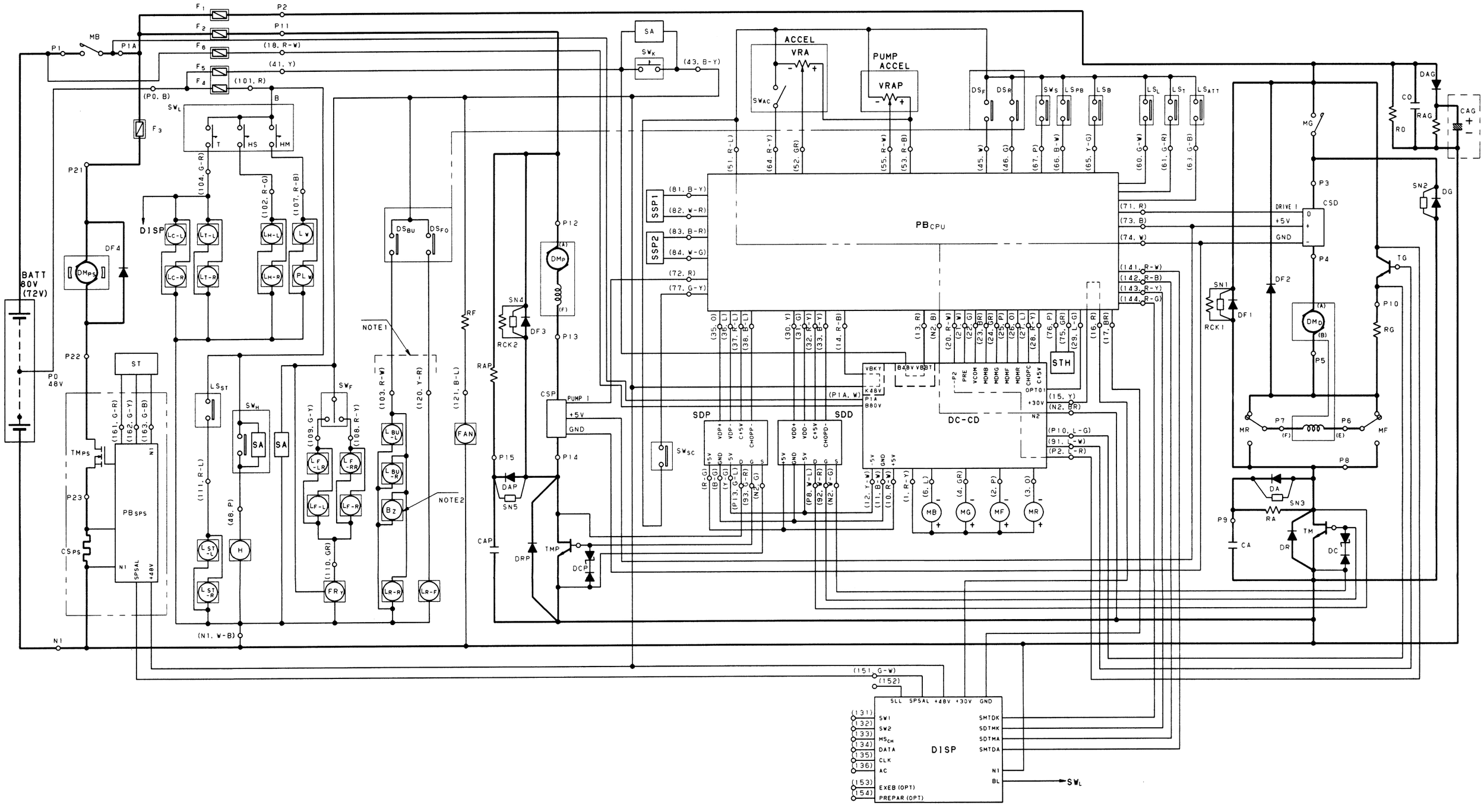
ADJUSTABLE-VOLUME BACK-UP BUZZER

FBMF 16-30 Symbolbeteckningar på elschemat

B Z	Backlarm
BATT	Batteri
CAD	Kondensator, drivmotor
CAG	Kondensator, regenerering
CAP	Kondensator, pumpmotor
CO	Kondensator
CS PS	Strömshunt, styrpumpsmotor
CSD	Strömshunt, drivmotor
CSP	Strömshunt, pumpmotor
DAD	Skyddsdiod, drivmotor
DAG	Skyddsdiod, regenerering
DAP	Skyddsdiod, pumpmotor
DCD	Skyddsdiodkrets för gate
DCP	Skyddsdiodkrets för gate
DF 1	Frihjulsdiod
DF 2	Bromsdiod
DF 3	Frihjulsdiod, pumpmotor
DF 4	Frihjulsdiod, styrpumpsmotor
DG	Diod, regenerering
DISP	Display
DM D	Drivmotor
DM P	Pumpmotor
DM PS	Styrpumpsmotor
DRD	Backströmsdiod, transistor
DRP	Backströmsdiod, transistor
DS BU	Brytare, backljus
DS F	Brytare, fram
DS FO	Brytare, fram (option)
DS R	Brytare, back
F1	Säkring, drivmotor
F2	Säkring, pumpmotor
F3	Säkring, styrmotor
F4	Säkring, belysning (48 volt)
F5	Manöversäkring (48 volt)
F6	Manöversäkring, DC/SD kortet
FAN	Kylfläkt
FR Y	Blinkrelä
H	Signal
L BU-L	Backljus, vänster
L BU-R	Backljus, höger
L C-L	Positionsljus, vänster
L C-R	Positionsljus, höger
L F-L	Blinkerslampa, Vä fram
L F-LR	Blinkerslampa, Vä bak
L F-R	Blinkerslampa, Hö fram
L F-RR	Blinkerslampa, Hö bak
L H-L	Strålkastare, Vä fram
L H-R	Strålkastare, Hö fram
L R-F	Roterande varningsljus, fram
L R-R	Roterande varningsljus, bak

L ST-L	Bromsljus Vä
L ST-R	Bromsljus Hö
L T-L	Bakljus Vä
L T-R	Bakljus Hö
L W	Arbetsbelysning bakåt
LS ATT	Brytare, extrafunktioner
LS B	Bromsbrytare
LS L	Brytare, lyft
LS PB	Brytare, parkeringsbroms
LS ST	Brytare, bromsljus
LS T	Brytare, tilt
MB	Huvudkontaktor
MF	Kontaktor, fram
MG	Kontaktor, regenerering
MR	Kontaktor, back
PB CPU	CPU kort, åkning och hydraulik
PB DC/CD	DC/CD kort, åkning och hydraulik
PB SPS	Kretskort, styrning
PL W	Indikeringslampa, arbetsljus bakåt
RAD	Resistor, skyddskrets
RAG	Resistor, skyddskrets
RAP	Resistor, skyddskrets
RCK 1&2	Resistor 1&2, kontroll
RF	Resistor, fläkt
RG	Resistor, regenereringskretsen
RO	Resistor
SA	Skyddskrets
SDD	Driverkort, transistor för åkning
SDP	Driverkort, transistor för hydraulik
SLL	Sensor, syranivå i batteri (option)
SN	Skyddskrets
SSP 1&2	Hastighetssensor 1&2
ST	Styrsensor
STH	Thermosensor
SW F	Blinkersomkopplare
SW H	Signalknapp
SW K	Nyckelbrytare
SW L	Omkopplare, belysning
SW S	Stolsbrytare
SW SC	Hastighetsbrytare (sköldpadda)
SWAC	Brytare, fartreglage (1 MS)
TG	Transistor, regenerering
TMD	Transistor, åkning
TMP	Transistor, hydraulik
TMPS	Transistor, styrpumpsmotor
VRA	Fartreglage
VRAP	Potentiometer, lyft

Toyota FBMF 16-30



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